SEP 19 1944

HEATING AND VENTILATING

COMMERCIAL, INDUSTRIAL AND INSTITUTIONAL AIR CONDITIONING, REFRIGERATION, PIPING, HEATING, VENTILATION

Air Conditioning Airfield Control Towers page 53

Revolutionary Method for Burning Anthracite Coal . . . . . page 56

Oil Piping — Its Design and Application . . page 70

New Degree-Day Normals for 210 Large Cities . . . . page 75

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HEATING AND VENTILATING

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MEMBER
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NEXT MONTH'S ISSUE

The series of articles on Blueprints of Post-War Realities, which has been so well received, has not been discontinued. The series will be interrupted next month to make possible an important reference section. Another of the blueprint series is being prepared for the November issue.

We present

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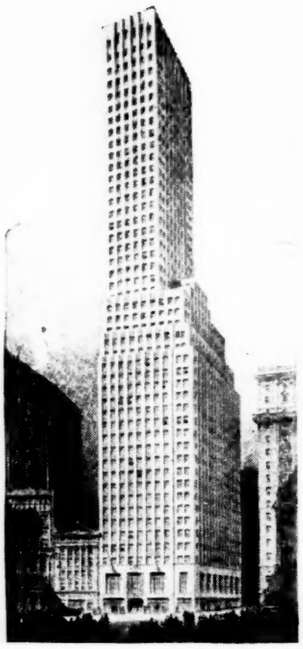

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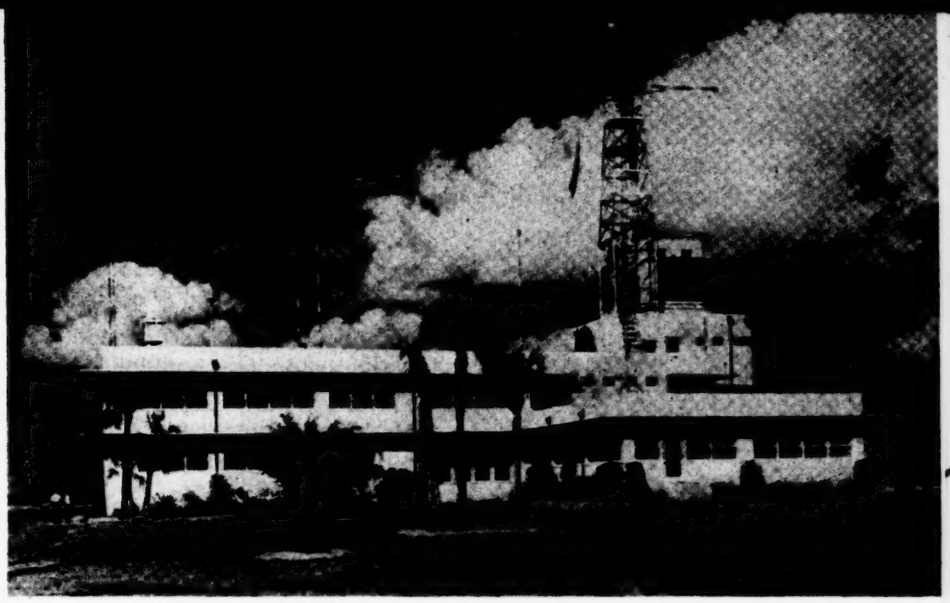


Operations building and control tower for a flying field of the armed services. Control towers are exposed to the sun on all sides and pick up large amounts of solar heat.

Air Conditioning Airport Control Towers

G. V. BOND
Field Engineer, Carrier Corporation, Syracuse, N. Y.

While at present there are 3,000 commercial fields large enough to require control towers, it is expected that this number will be increased to 6,000 in the immediate post-war period, and about $800,000,000 will be spent in the construction of these fields.*

THE control tower is the nerve center of every airport. Orders to pilots entering and leaving, constant communication with planes within a wide radius, frequent checking and dispatching of weather reports — all these functions require top efficiency of personnel and apparatus in the tower.

In these glass-enclosed observation posts, exposed to the sun, air conditioning is a must. Windows must be closed against the ever-present menace of dust to sensitive apparatus. Without cooling, they become hot-houses in which operators rapidly lose efficiency, thereby courting the danger of serious accidents. Air conditioning maintains both the temperature and humidity necessary for efficient work, and cleans the air introduced for ventilation.

Varying in layout, control towers for commercial airfields present individual problems to the air conditioning engineer. The Army and Navy, however, have standard designs. A typical Army tower is a free-standing steel structure, 50 feet high and 15 feet square. Floors, walls and roof of the control room are heavily insulated. Forming the perimeter of the room are glass panels, 5½ ft high, which slant outward slightly toward the top to minimize glare.

The Navy tower, which usually surmounts the Operations Building, is hexagonal in shape, and contains panelling of a special, heat-absorbing and glare-decreasing glass. This glass slants sharply outward from the base, then inward to form a transom. Although this design gives clear vision of both ground and sky, it has an extremely high rate of heat gain.

In most locations, air conditioning with refrigeration is required. There are some zones, however, in which tolerable results may be obtained by properly designed ventilation, or an evaporative cooling system. The latter is effective in arid regions in which wet bulb temperatures average below 70F.

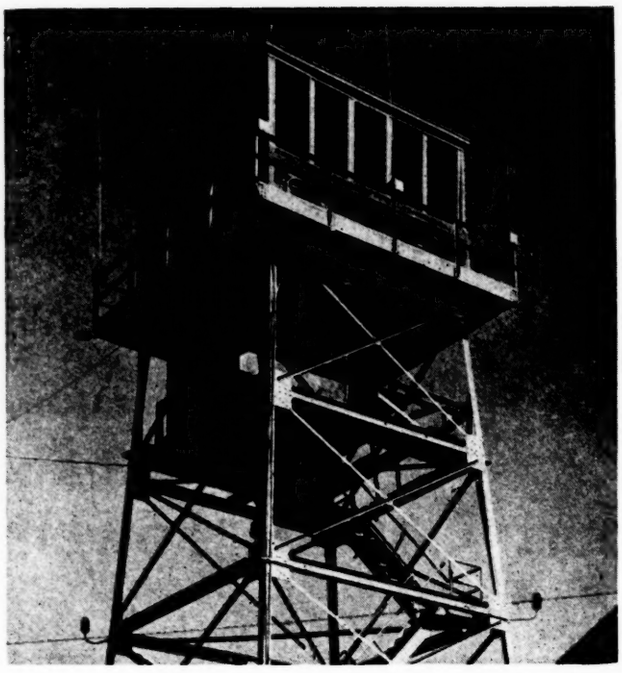
Ventilation may be designed to limit the temperature rise within the tower to 7.5F above that of the outside, whereas in an unconditioned tower, the rise may be as high as 25F, resulting in a temperature of 120F, when it is 95F outside. It is satisfactory for efficiency of apparatus and personnel to provide a temperature of 80F with 50 degrees maximum relative humidity.

Heat gains are estimated in the usual manner, and include heat from five sources:

1. Walls, ceiling and floor.
2. People (usually six).
3. Lights and radio equipment (from one-half to one kw.
4. Outside air (120 cfm, or 20 cfm per person).
5. Glass.

Heat gain through the glass, from sun radiation and transmission, accounts for approximately 75 per cent of the sensible heat. It is important, therefore, to determine this part of the load accurately. In many towers, special heat-absorbing glass is used to reduce the load. Factors for sun radiation through this actinic glass may be cut, safely, to 60 per cent of those for standard glass.

*According to an estimate by the Administrator of Civil Aeronautics, U. S. Department of Commerce.



An example of a U. S. Army type control tower.

It is unsound, economically, to insulate heavily the walls, floor and ceiling of a control tower, because transmission through these surfaces is a small portion of the total load, and the slight saving in heat gain is more than offset by increased cost of insulation. In some areas, cold winters dictate other practice.

If the outside design temperature is 90F or less, the air conditioning engineer may consider the advisability of a ventilation system. Because extremely large quantities of air will be required, it is well to design for a temperature rise of approximately 7.5F in the tower. To determine the proper air quantity, heat gains from the sun and electrical equipment in the tower should be totalled and divided by a factor of eight. The answer will be the required cfm of air for ventilation for a 7.5F rise. In a typical Army tower this air flow will be approximately 2,000 cfm, or a one-minute air change.

In designing the ventilation system, air should be filtered first, then supplied to the tower, to create a slight pressure which will tend to prevent infiltration of dust. With this arrangement, it will be necessary to provide balanced relief dampers, or an exhaust fan of capacity slightly less than that of the supply unit.

Although a ventilation system is relatively low in cost, it affords only partial relief. Under maximum conditions, temperature in the tower may rise to approximately 98F. Because dehumidification is not provided, instruments within the tower are subject to corrosion.

With a 70 degree wet bulb design limit for evaporative cooling systems, the engineer may obtain the desired 80F temperature within the control tower. However, this will require an exceptionally large quantity of air. An efficient evaporative cooling unit is usually limited to 80% saturation, which would result in a 75F temperature of the supply air.

Before selecting the type unit, the supply air temperature equivalent to 80% saturation at the design wet bulb temperature should be determined first. The difference between this temperature and the condition of the room will give the air temperature rise for the maximum load. The air capacity of the unit may be determined from the sensible heat load and air temperature rise.

Control for Overcooling

Because the evaporative cooling unit is in reality a humidifier, it is important to provide a control to prevent over-cooling, with resultant high humidities under light loads. An effective method of accomplishing this is to control an air by-pass, around the humidifying unit, with a room thermostat and damper motor. The saturation, and therefore the temperature of the supply air, will be controlled, thus balancing the sensible heat load and maintaining conditions in the room at the thermostat setting. Again, filters and a relief system should be provided.

Both first and operating costs should be less than those for a refrigeration system. A considerable quantity of water is required, however, for evaporation, and in an arid region it may be advisable to install a refrigeration system with aircooled condensers, which operate without water.

The average air conditioning load in a control tower varies from three tons in the 15x15 ft Army tower, to five to seven tons in the larger and more exposed Navy tower. The load is mostly sensible heat, and very little dehumidifying will be required.

Commercially available self-contained air conditioning units may be applied effectively. These units are designed, however, for lower ratios of sensible to latent heat, and care must be taken in selecting the proper units to handle the sensible heat load. For example, a unit rated three tons may have only two tons' net sensible heat output. It is sometimes possible to raise the sensible heat capacity of a given unit by increasing the quantity of air.

Most self-contained air conditioning units large enough for control towers require water for condensing the refrigerant. To avoid the use of water, it has been found advantageous to install a fan, coil and filter unit with an air-cooled condensing unit. This arrangement enables the engineer to balance better his equipment with load conditions. He may select his cooling coil and air quantity for the desired sensible to latent heat ratio and sensible heat load.

Variable Sun Load

The sun load is large and is subject to wide variations, which might indicate the need for very flexible control of refrigeration. This could be provided by means of a two-speed compressor motor, or reheat. However, the additional cost does not appear justified. While some installations have two air-

cooled condensing units which can be operated from a two-step thermostat for control of capacity, most systems have only on and off control of a single compressor from a room thermostat.

In many commercial towers, and those found at Naval bases, room for the air conditioning or ventilating unit may be found in the building on which the tower is set. The free-standing Army tower, however, presents a more difficult problem. Space requirements, and necessity for clear vision prohibit the installation of bulky equipment within the control room. It has been necessary, therefore, either to suspend the equipment underneath the floor of the control room, where it must be protected from weather, or to support it on a platform thrown across the level directly under the room.

The high sensible heat load requires a large air quantity for the cubic content of the room. To diffuse the air to best advantage, and distribute it where needed for effective cooling, outlets in window sills have been found most satisfactory. In fact, it would be impossible in most towers to extend a duct to the ceiling without obstructing vision.

The return air is taken through a grille, preferably in the wall at floor level. Outside air, supplied by a refrigeration system, provides sufficient pressure to minimize dust infiltration. Relief louvers will be unnecessary, because leakage of the building is usually sufficient to relieve the quantity of air supplied.

Motors must be of the induction or capacitor type, to reduce radio interference. This is of vital importance if equipment is to be installed in the control room.

If a water-cooled condensing unit is used, the engineer should check the water pressure, because the equipment is located some 50 feet above the ground. There may be insufficient pressure at this point to overcome the resistance of the water regulating valve and condenser. An oversize valve often is required.

Some systems have been installed with the compressor on the ground, and the evaporator under the floor of the control room. This was done to overcome low water pressure. Caution is required to maintain the condensing pressure at a level sufficient to force the liquid refrigerant to the evaporator, and overcome the resistance of the expansion valve. A liquid sub-cooler must be added to minimize flash gas in the liquid line, owing to the change in pressure from compressor to evaporator, 50 ft above. It may be necessary, also, to over-size the expansion valve.

Inside the control tower at a naval air station.

In a temperate climate, heating is essential. A heating coil may be added to the air conditioning unit, to make a year-around system. Air distribution from the window sill is ideal for the heating cycle. Hot water or steam is rarely available for heating Army towers, and it is standard practice to install electric unit heaters in the control room. Conditions might be improved by adding electric strip heaters in the supply duct of the air conditioning system. The result would be controlled ventilation, filtering and good air distribution.

Temperatures in Chimneys

Low-cost and special defense housing construction has invited the use of chimneys that are much lighter, less expensive, and less permanent than the conventional brick construction. Because of their low cost, lightly constructed and partially prefabricated designs have been submitted to the Bureau. The testing of these has called for considerable special equipment.

To aid in establishing performance requirements, tests were conducted recently by the National Bureau of Standards with a lined and unlined brick chimney, both having 4-in.-thick clay brick walls. A constant flue-gas temperature was obtained with a gasburner at the base of the chimney. Surrounding the chimney above the burner inlet was a floor construction representative of details applied in dwellings. The floor joists were spaced 2 in. away from the chimney, but the edges of the floor boards and the nailing strips for the base trim were in contact with the chimney, except that for the unlined chimney and for one side of the lined chimney, a single thickness of 15-lb asbestos paper was placed between the brick and the wood. It was found that the unlined chimney created a hazardous condition to the surrounding woodwork with a continued flue-gas temperature of 900F, and the lined chimney with a flue-gas temperature of 1,100F. However, this condition did not obtain for the lined chimney until after 13 hours, and a slightly shorter period for the unlined chimney.

A number of firing tests were conducted with heating equipments known to give high flue-gas temperatures, using wood and soft coal as fuels.

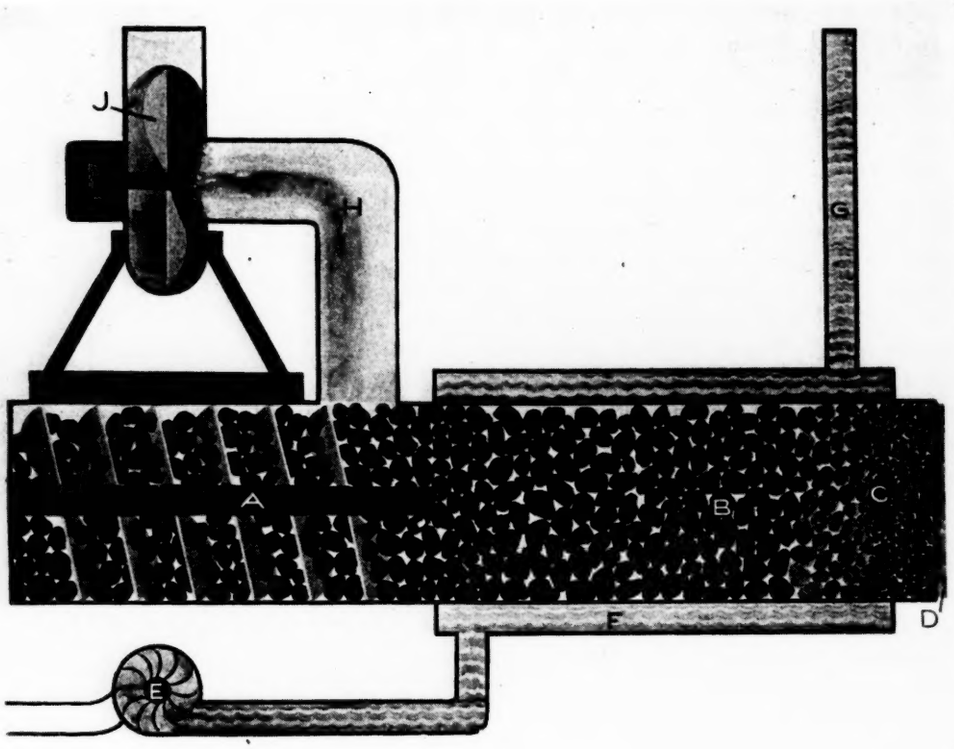


Fig. 1. The method of burning anthracite, developed at the Anthracite Industries Laboratory, Primos, Pa. The mechanism for applying the principle is a tube surrounded with a water jacket. A revolving worm A introduces the coal automatically into one end of the tube. Coal burns in the tube B, and ash is discharged at the other end C. Air for combustion enters at the ash end of the tube D and is drawn through the fuel by an induced draft fan J in the smoke pipe H. Water F is circulated around the tube by a circulator E.

Revolutionary Method of Fuel Burning for Anthracite-Fired Heating Plants

A METHOD of burning anthracite which involves no secondary air, no indirect heating surface, and which will make possible a highly compact automatically-fired boiler, coupled with other advantages, was demonstrated last month by Anthracite Industries, Inc., at its Laboratory in Primos, Pa., at meetings presided over by Frank W. Earnest, Jr., president of Anthracite Industries. The principle was developed at the Laboratory under the direction of Dr. Raymond C. Johnson, vice-president in charge of research of Anthracite Industries, Inc.

Adaptable to hot water, steam or warm air systems, the mechanism for applying the new principle is simple, as illustrated in Fig. 1. It consists of a tube 6 or 8 in. in diameter and approximately 18 in. long. Anthracite is fed into the tube by a worm; the coal burns in the center of the tube, and the ash is discharged at the other end. Heat is transferred to a water jacket from which it is circulated to the radiators or, if a warm air system is contemplated, to a heat exchanger over which air is blown and heated.

Development of Principle

New techniques for utilizing anthracite have been under investigation at the Laboratory since 1936 when Pennsylvania anthracite mine operators representing 70% of the hard coal output formed Anthracite Industries, Inc. New markets were explored, tests on a wide variety of anthracite burning equipment were conducted, bulletins of aid to house-owners and others were published and distributed. For the past several years intensive research has been carried on at the Laboratory on the fundamentals of anthracite combustion. The principle announced last month represents the result of this work to the present time.

According to Dr. Johnson, available combustion and heat transfer data on anthracite burning and related equipment were meager. For example, little was known about the proportion of heat transferred by conduction from the coal to the water walls, by radiation from the fuel to the direct heating surface, and by convection to the secondary surface. Conventional boilers and furnaces have large grate areas with extensive combustion space above the fire bed so that the carbon monoxide could be burned above the bed with secondary air. As a result, such equipment has been bulky and heavy.

In an attempt to develop much-needed data on the fundamentals of anthracite combustion, the fuel was burned in pipes of varying diameter. It was found that as the diameter of the pipe was de-

creased, the unit heat transfer was increased. This was explainable by the fact that as the diameter decreased a larger part of the coal was in direct contact with the water-jacketed walls and the incandescent bed of coal in the center whose heat had to be transferred by radiation or convection became smaller. Ultimately a diameter was reached when, for a given size coal, the intense hot zone was eliminated as shown in Fig. 2, and practically all the coal was in almost direct contact with the cool walls and losing its heat to those walls. There are few interstices between coals in the center of the fuel bed, but there are air spaces around the edges; consequently, as the pipe diameter was decreased, the air spaces were relatively increased, with the result that primary air is available in sufficient quantities to burn the fuel completely and rapidly.

Arrangement of Equipment

The equipment finally evolved from the experimental work consists primarily of five elements: The water-jacketed steel tube; a worm to feed the fuel into the tube; an induced-draft fan; a circulator for the water, and a motor to drive the fan, screw and circulator. See Fig. 1. The complete device, of a capacity to heat up to a nine room house, will, it is anticipated, be enclosed in a space less than 2 x 2 x 3 ft and with the boiler (tube and jacket) weighing about 75 lb. It is further expected that the complete unit can be sold and installed for a price less than other automatic fuel-burning devices.

The sharp reduction in size of unit is made possible by the greatly increased rate of heat release and heat transfer. According to Dr. Johnson, those rates, averaged, compare with the design factors for conventional equipment as shown in Fig. 3. In this chart, the burning rate is per square foot of grate per hour for the conventional type heater, and per square foot of cross-sectional tube area for the new method; the heat liberated per cubic foot per hour is in terms of total boiler volume, conventional type, and per cubic foot of tube contents for the Laboratory device; heat absorbed per square foot of heating surface per hour is an average of both direct

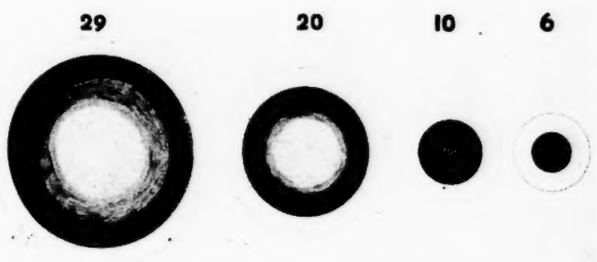


Fig. 2. Horizontal cross-sectional views of firepots of varying diameters each surrounded by a water jacket, showing relative temperatures of the fire beds from outer edge (deepest shaded area) to center (lightest area). Note that the temperature at the center of the fire bed is reduced as the firepot decreases in diameter, giving a more uniform over-all temperature.

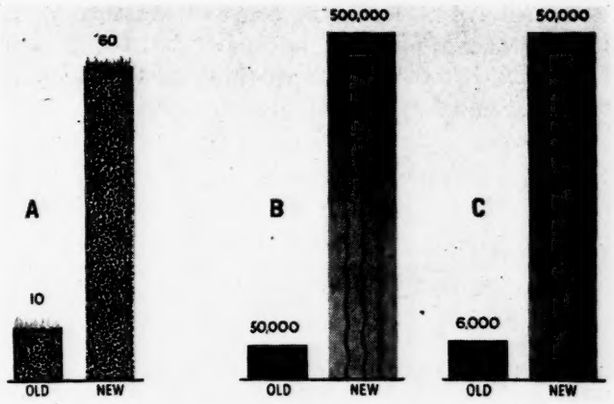


Fig. 3. Relative average combustion and heat transfer rates of a typical domestic boiler compared with average rates of the new method. A—burning rate per sq ft of burning surface per hour. B—Btu liberated per total boiler volume per hour. C—Btu absorbed per sq ft of heating surface per hour.

and indirect heating surface for the usual small boiler, and per square foot of inside pipe surface area for the new method. In both cases the figures are averages, not maximum rates.

The new method, as illustrated in Fig. 1, has no secondary heating surface, so that there is no opportunity for soot and fly-ash to form and reduce heat transfer. The scrubbing action of the coal keeps the tube surface clean. Also, according to the Laboratory, the coal cannot clinker in the new arrangement. In spite of the higher rate of burning, it is not possible for clinkers to form, because the small size of the fire bed permits the water surrounding the tube to carry off the heat so rapidly that the actual temperature of the burning coal is lower than the temperature at which clinkers form in an anthracite fire.

In adaptation to fully automatic equipment, the anthracite is fed into the tube by a conveyor leading directly from the coal supply. Ash is discharged into enclosed, dust-proof containers, which would need to be replaced only two or three times a week, or directly into pits prepared for the purpose outside the basement. The amount of heat desired is regulated automatically by thermostatic control. Fig. 5 shows two of the units under fire in the Laboratory.

The principle of the Laboratory's method has been patented by Anthracite Industries, Inc., which proposes to license, on a royalty-free basis, boiler, furnace, and stoker manufacturers to employ the principle in units of their own design. The device is not, in its present state, commercially available, nor will it be until manufacturers have adapted the principle. Under the proposed method of licensing, each manufacturer will have the opportunity to overcome problems and limitations in his own way. A number of manufacturers are already reported working on designs embodying the new principle.

Only domestic size units have been tested so far. Commercial and industrial size units may be

developed later. Since the basis of the theory underlying the principle is a small tube, the present outlook is that large units would consist of a multiplicity of small tubes in parallel.

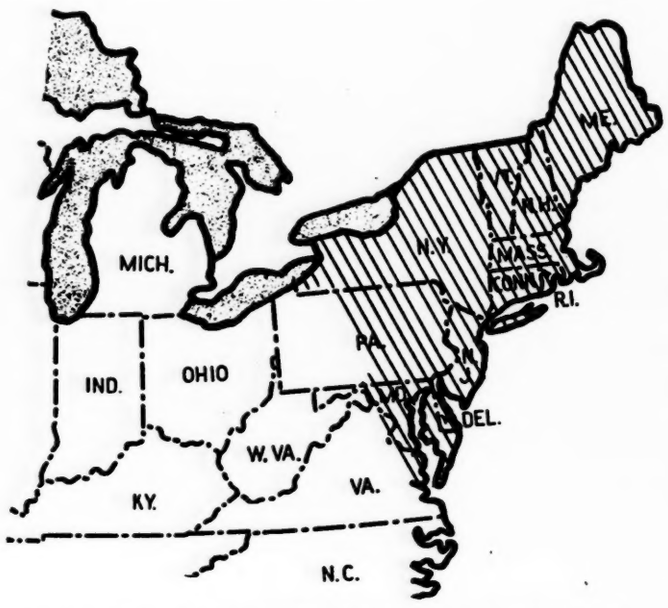


Fig. 4. The primary anthracite consuming section of the United States. Relatively insignificant percentages of total anthracite production are shipped to other areas, including exports to Canada.

Significance of Device

The objective of Anthracite Industries is to increase the market for anthracite. The anthracite consuming area is the northeastern portion of the United States which, although limited in scope, is the most densely populated section of the country (See Fig. 4.). If a simple completely automatic boiler or furnace can be made available at a relatively low cost and operating as economically as the test models, anthracite may again become a really formidable contender in the Battle of the Fuels in the eastern states.

New business gained would be mainly at the expense of oil and gas. The anthracite-burning region is almost wholly a manufactured gas region where rates are relatively high. Thus, in general, it would appear that gains made by anthracite would be primarily in installations where prior to the war oil was in the dominant position.

Questions Asked

Questions regarding the new principle are so numerous that space does not permit covering all of them. Those which follow are, however, of special interest, and are accompanied by answers given by Dr. Johnson:

Q. What is the efficiency of the laboratory models?
A. In the high sixties.
Q. What CO_2 is obtained?
A. From 16 to 18%
Q. What flue gas temperatures?
A. From 250 to 300F.
Q. How far can the burning rate be slowed down for banking?
A. To about 2% of the maximum rate.
Q. How is the fire started?
A. By a kindle pack inserted at the far end of the tube.
Q. How are the fan and screw of the device synchronized?
A. The same motor drives the fan, the worm and the circulator.
Q. What is done if steam heating is desired?
A. The water jacket is eccentric, with a center above the tube center, allowing for steam space.
Q. How about warm air?
A. A heat exchanger would be introduced—probably of the extended surface type. It could be a unit heater arrangement.
Q. What about service hot water?
A. Can be taken care of as by any other boiler, year round.
Q. What size coal is used?
A. Chestnut is recommended, but pea can be burned efficiently in 4 or 6 inch tubes.
Q. Can increased capacity be obtained by a longer tube?
A. No. The coal tends to clog with a screw feed when a tube is over 18 in. long.
Q. Can bituminous coal be burned in this device?
A. No tests were run on bituminous. Due to the difference in volatile content, probably not with the present design.
Q. Is hopper- or bin-feed recommended?
A. Either could be used, depending on the designer.
Q. Can anyone use the principle?
A. Qualified manufacturers, under license, royalty free, with the provision that they really cooperate in producing and offering such a unit for sale.

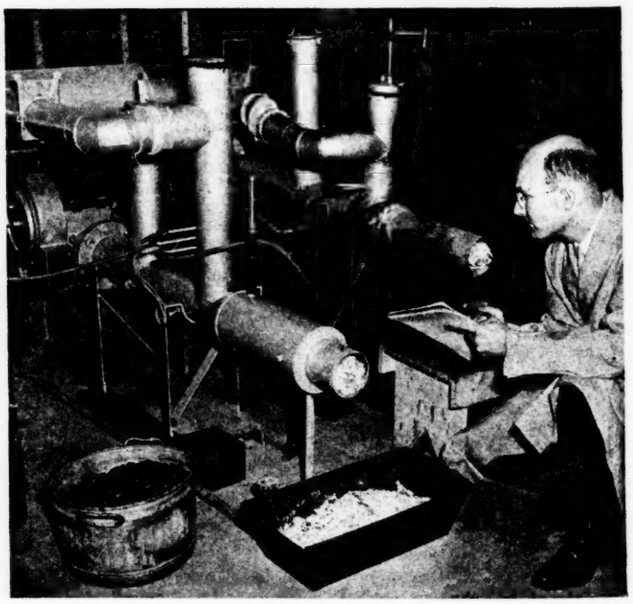
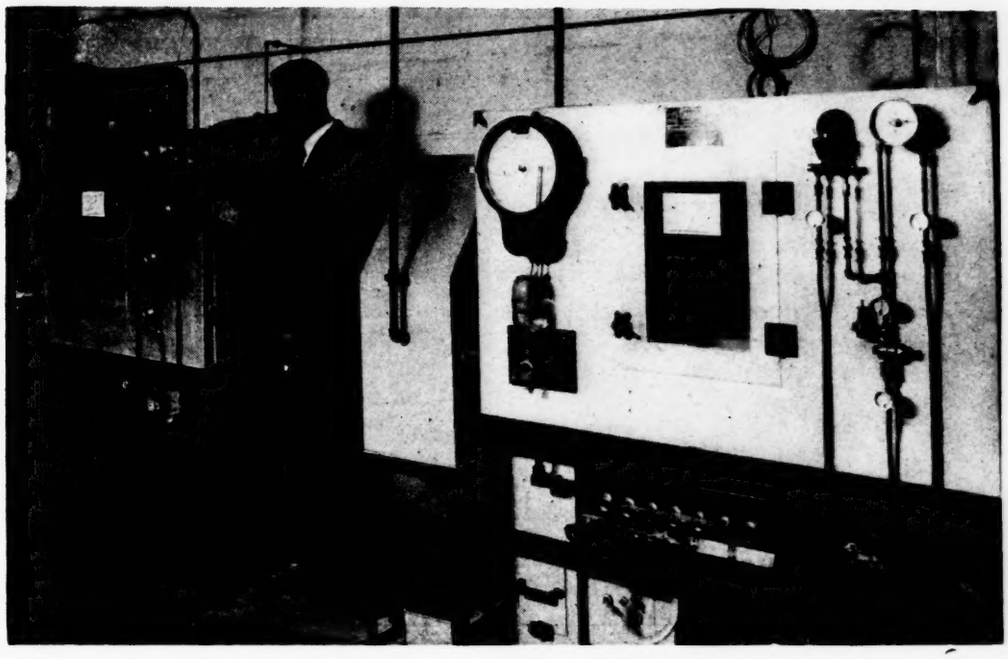


Fig. 5. Two of the anthracite burning units under test in the Laboratory at Primos.



Atmospheric test cabinets are used to determine the most desirable air conditions for a new product, prior to the design of the air conditioning systems that will serve the plant under production conditions.

Case Histories in Air Conditioning

E. L. SCHULZ
Engineer, Carrier Corp., Syracuse, N. Y.

Information regarding zoning, product served by air conditioning, and the importance of operating instructions.

THERE was a time when zoning was considered for only the gold-plated job. When enough money was invested, the job was split up into zones. Most other jobs, however, were installed on the basis of minimum requirements. Today, these qualifications are no longer used, and on most present day installations, "minimum requirements" include zoning.

Improper zoning, which is always a danger, might fall into one of three classifications: Insufficient zoning, zoning of improper areas, or improper zone control.

The last, while occurring infrequently, provided an interesting experience a few years ago at a job which involved the conditioning of 14 executive offices in a large manufacturing plant. It was decided to zone each room individually and thus satisfy the desires of every occupant.

Just before the contract was accepted, the purchaser requested a price reduction to bring the cost in line with the appropriation. Unfortunately, it was agreed to take this cost reduction by eliminating certain heating functions originally assigned to the air conditioning system. As this was an existting building, the hand controlled steam radiation for winter heating was allowed to remain and only a low temperature rise steam coil was placed in each air supply duct for a minimum quantity of reheat to take care of tempering the supply air to each room. Controls were so arranged that a central dehumidifier supplied air at a constant dew point for delivery to rooms. The proper dry bulb temperature was maintained in each room by wall thermostats which controlled the steam supply to the reheaters.

The installation proved a huge success during its first summer of operation, but winter brought trouble. Unfortunately hand control valves had been left on every radiator in the building. Whenever an occupant felt cool he would unconsciously go over and open up the radiator valve. He had not been sufficiently impressed with the desirability of resetting the reheat thermostat controller. Opening the steam valve on the radiator immediately caused the reheat steam valve to throttle. In a few minutes, the supply air to the room would blow in at around its dewpoint temperature

This article is based upon experiences in the air conditioning field accumulated in recent years by several companies, and by technical men in various parts of the country. Since it is not a record of one man or one company, the findings have much more than usual significance.

TABLE 1.—COMPARATIVE MERITS OF ZONING METHODS*

	Type	Supply and Ventilation Air Volume	Air Cooling Apparatus Size Determined By	Refrigeration Apparatus Size Determined By	Is Simultaneous Heating-Cooling Possible?	Comparative First Cost	Comparative Operating Cost	Comparative Quality of Results
A.	Separate Apparatus for Each Zone	Constant	Each zone maximum load	Bldg. maximum load	Yes	High	Lowest	Good
B.	Zone Recirculating Fans	Variable	Building maximum load		Only by adding reheat (D)	Medium	Fairly low	No good without reheat Good with reheat
C.	Dual Duct System—Cooling through one duct heating through other	Constant	Building maximum load		Yes	High	Lowest	Good
D.	Reheat or Re-Cooling	Constant	Sum of zone maximum loads		Yes	Medium	High	Good
E.	Volume Dampers	Variable: maximum to zero	Building maximum load		Only by adding reheat (D)	Low	Low	No good without reheat Fair with reheat

*From "An Analysis of Zoning" by Walter A. Grant, *Refrigerating Engineering*, June, 1940.

of 42F. Radiation in the room was thus bucking the thermostat controlling the reheat on the air conditioning apparatus. Quite naturally the cold drafts were very objectionable.

It became a complaint among the occupants of these offices that the wider they opened the radiator valve, the colder it got in the room. This complaint was easily remedied by removing individual hand radiator valves. In their stead, a single main steam valve was installed in the steam supply line to the building heating system. A special outside the wall thermostat proportioned the amount of steam flow to the radiators in accordance with the outside air temperature. Individual room variations could then be compensated for by means of the room reheat thermostats.

Before this job was removed from the books, the very important problem of customer psychology entered the picture. Unfortunately, corrections to the heating system could not be made until the system was shut down in the spring, and the results of these corrections were not felt until the following winter. However, throughout the second summer, it was necessary to answer many complaints regarding drafts, on the same system which had operated to the owner's satisfaction the first summer. A considerable amount of customer psychology can be seen in this complaint.

Even though no change was made in the summer operating cycle, occupants of those rooms had lingering memories of the operating faults during the previous winter. It became natural to imagine drafts where no drafts existed.

While the jobs described had almost too many zones, probably many more complaints originate on jobs with insufficient zoning. There are two faults found in attempts to zone. The first is where zones are selected by floors only, and where no consideration is given that the sun load on the outside walls will vary during a day's operation. The second fault is that zones are selected by exposure of certain walls. This also causes trouble if there is a top floor with a sun load on the roof all day long.

Product Served by Conditioned Air

Another title of this section could be "unfamiliarity with product to be conditioned." This applies to an industrial job where there is a product to be humidified, dehumidified, cooled, or heated. Obviously, there is little need to mention where the responsibility lies if a contractor fails to obtain full information on the product, to determine, in turn, its influence on apparatus design.

If the information is available before the job is installed, it should be used in the design of the system to avoid a failure of the conditioning apparatus to maintain proper conditions. However, if the characteristics of the product are not known, the obligation of the contractor takes an entirely different form.

A few years ago considerable publicity was given the advantages of air conditioning in the manufacture of effervescent salts in the drug industry. In this particular phase of drug manufacture, its value was unquestioned. It was obvious that air conditioning would not be a "cure-all." However, many people, vexed by some difficulty in their manufacture, grasped at air conditioning.

One manufacturer discovered on the day set aside for starting his new air conditioning system what had caused the difficulties with his product, and it was not anything that air conditioning could cure.

While the air conditioning salesman had negotiated this contract in perfect faith, he did not exert sufficient effort to get full information on the product to be conditioned. Had he done so, he would have

discovered that this product was in no way affected by changes in temperature or relative humidity.

This story might be contrasted with that of the manufacturer who felt that air conditioning would be desirable in handling his product. However, the characteristics of the product were relatively unknown. This customer was willing to go ahead with a complete air conditioning system based on the contractor's recommendations.

Here was an opportunity for a salesman to get a very substantial contract and, if the job worked, all would be well. Should the job be a failure, the contractor would carry a moral obligation to the customer—and probably lose the customer's faith. The salesman insisted that the customer purchase a pilot plant at approximately 1/20th of the cost of the job originally discussed.

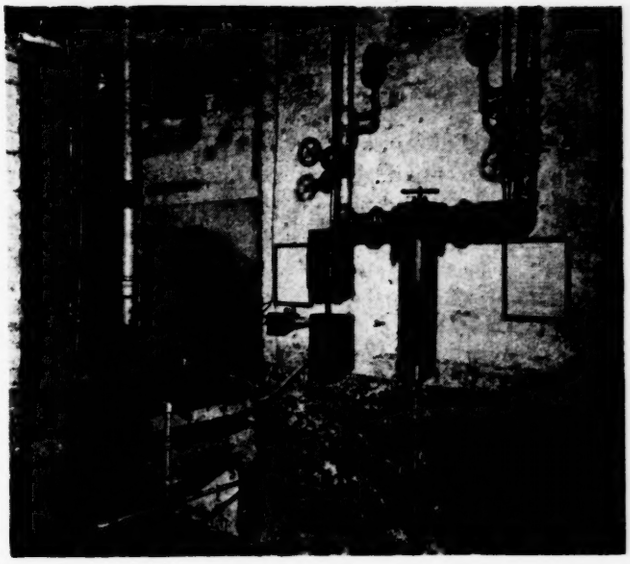
Results of the pilot plant experiments proved mutually beneficial. To the customer it proved that he definitely needed conditioning in handling his products, and that the optimum conditions required for the conditioning apparatus were considerably below the assumed values on which the original negotiations were based. The salesman not only sold his complete job, but actually sold more apparatus than originally anticipated—the pilot plant and the complete job. He so established himself that he was consulted on all air conditioning problems that arose in the plant.

Compare this experience with that of another plant operator. Several years previous, an industrial air conditioning job was installed by an engineering contractor who seemed extremely anxious to undersell all competition. This appealed to the customer for he was strictly a buyer on price. Neither party to the negotiation seemed concerned with the product to be conditioned other than assuming that any air conditioning would be sufficiently beneficial to double, or even triple, output. The buyer cared little for engineering details. They were never allowed to enter the negotiations. This contractor put in the cheapest job possible, in inadequate capacity and improper controls, in an attempt to break even on the job.

Many difficulties were encountered during the initial operation of the equipment. The buyer unexpectedly developed interest in the engineering details. His lawyer found many weaknesses in the poorly worded contract and eventually forced the contractor to rebuild the system. Cost of the changes was almost enough to drive the contractor out of business.

Two serious faults can be charged to this contractor. In the first place, he was careless in preparing and submitting his contract papers. But this error is insignificant in comparison to his mistake in failing to recognize the engineering requirements of the product.

The contractor allowed himself to be misled by the customer's apparent indifference to the engineering details of the installation. Therefore, the job engineering was aimed to lay out a system that would get by.



Framed operating instructions adjacent to the control system of an industrial air conditioning installation provides handy instructions for the operating engineer.

No engineering contracting organization can afford to accept a contract of this kind today, yet there are still those who are willing to place orders on such a basis.

Operating Instructions

Once a job has been placed in initial operation, the next step is to turn over the equipment to the purchaser's operating men. A new point of vulnerability has been struck where the future success or failure of the job depends on the type of operating supervision. Regardless of how well an installation may be engineered and constructed, it can only be as good as its operator will permit.

It is the duty of the salesman, engineer, and constructor to sell the equipment operator on the system that is to become his responsibility. Throughout the sales, design and construction periods, the operator should be consulted or, if that is impractical, he should be advised of the decisions made in regard to "his" system.

Then, when the job is complete and running, the contractor should furnish competent instructors for a sufficient length of time to permit the operating engineers to gain complete confidence in the new machinery.

In this connection every job should receive several copies of operating instructions written in the most complete form possible. If a second, third, or possibly a fourth job is installed in the same plant or building, and is under the same supervision, operation instructions for these additional installations should be independent, completely self-contained, and with no reference to instructions for the other installations.

In one particular plant, a second set of refrigeration and air conditioning apparatus was installed

within the same apparatus room as the original installation. There was a reasonable similarity between the two jobs. In completing the operating instructions for the second job, it seemed desirable to save time and paper by shortening up general description of apparatus, function of controls, and various operating sequences. In its stead reference was made to the operating instructions on the original job. As often happens, the original operating instructions were lost.

Then there was a change in operators. The replacement engineer was poorly instructed by his predecessor and spent weeks attempting to fathom out the intricacies of the two air conditioning systems. There were no written instructions evident on the old system and the instructions which he had for the new system were practically worthless to him because he was unable to refer to the original instructions on the first job.

Within a few weeks, many of the control and safety control instruments were out of calibration. Before long, there was a serious freeze-up of the cooler on the refrigeration plant. A good deal of this difficulty might have been avoided if the second set of operating instructions were more complete.

One might wonder why the owner did not ask the contractor to instruct the new operating engineer. Unfortunately, it is a trait of some owners to assume that the system will take care of itself after it has been successfully operating for several years. He assumes that his new engineer need not know too much about the system, so why bother to call on the equipment manufacturer.

Another case involved a job of extremely simple layout. It was felt verbal instructions would be sufficient to permit the customer to operate his system successfully. The system was supposed to be fool-proof. Unfortunately, the operating man was inquisitive, the type who has a way of doing things "better" than anyone else. In a short time he completely neglected, or forgot, the verbal operating instructions given him, and he was operating the system according to his own ideas.

The system failed and expensive repairs were required. The customer, in attempting to place the responsibility and cost for repairs on the engineering contractor, used as his defense the fact that no written instructions were provided.

Of course, the expedient of simply furnishing the owner and operator with a set of operating instructions is by no means a guarantee of the proper operation of the system. Often a well written set of instructions is placed in the engineering office files and never reaches the men charged with the responsibility of operation.

The mere fact that instructions are located in the apparatus room is no guarantee that the data will be studied and preserved by the operating personnel.

Therefore, it is good policy to prepare for all eventualities. Copies of the detailed operating instructions should be made for the engineering files and also for the system operators. In addition, a short, concise description of the sequence of operation should be framed and placed in a prominent position in the apparatus room.

Corrosion in Steam Heating Systems

Corrosion of steam heating systems is due principally to carbon dioxide, which acidifies the condensate. One method of preventing corrosion is to introduce sufficient amine into the steam to neutralize the acidity. The use of cyclohexylamine for this purpose has been studied both in the laboratory and in an operating system, according to Bulletin R 1.3754 on "Observations on the Use of Cyclohexylamine in Steam-Heating Systems," published by the Bureau of Mines.

The amine is very volatile from boiling water, so much so that it appears to leave the boiler with the steam practically as soon as it enters with the feedwater. To maintain an alkaline condition in the condensate at traps and heaters, frequent and preferably continuous additions of amine must be made to the system.

Losses of the volatile amine probably occur at every vent in the system. Large quantities of the chemical were found in the vented vapors from the deaerating heater. Loss was negligible in the blowdown water but appreciable in the condensate that was not returned to the system.

In a system that is amine-treated all of the carbon dioxide in the steam tends to be fixed in the condensate and returned to the boiler for recirculation. Condensate which is not returned to the boiler is important, not because of its amine content but because it must be replaced by raw water, the source of additional carbon dioxide. For this reason, loss of water as blow-down is almost as expensive in terms of make-up amine as loss of condensate, although the former contains no cyclohexylamine.

Cyclohexylamine treatment has helped reduce return-condensate corrosion in steam-heating systems. This result cannot be attributed entirely to its alkalinity, for in many instances the quantity of amine in the steam was small as compared with the carbon-dioxide content. It is probable that the amine can inhibit corrosion in the manner peculiar to the nitrogenous bases to which it is related.

All of the defects in the use of cyclohexylamine in steam systems are due to its excessive volatility. This disadvantage is not unsurmountable, since it can be overcome through determining a less-volatile amine of the same desirable properties. Amine treatment has been shown to be useful in steam systems where return-line corrosion is a serious problem.

Saving Fuel in the Home

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FURTHER economies by all consumers in the use of oil, gas, and solid fuels, were requested by the Solids Fuels Administration for War, in order to balance the fuel budget. For the period including the 1944-45 heating season, the production forecast indicates a shortage of at least 16,000,000 tons of bituminous coal and 5,000,000 tons of anthracite. It is obvious that if we continue our normal lavish and wasteful use of these fuels our war industries will suffer and many of our homes will be uncomfortably cold this winter.

This deficiency in the supply of solid fuel occurs largely in the premium coals produced in the eastern Appalachian field, which are normally used, and are still required, for metallurgical, gas, and by-product application. Other industrial and domestic consumers, who use these grades, therefore must institute plans to reduce their normal needs by 15 to 20% or substitute inferior grades that may be available.

For many years, the writer has been active in stimulating the economical use of bituminous coal and formerly acted as Fuel Efficiency Coordinator for the Metropolitan New York Area, organizing a Fuel Efficiency Program under the Bureau of Mines. This program is directed to the consumers of all fuels, from the small four-family flat to and including the largest industrial and utility consumer. S.F.A.W. is now starting a conservation program for the domestic consumer and it has occurred to me that the actual savings which were accomplished in my own domestic heating, during the last two seasons, as a result of a savings program that was started in the summer of 1942, would be a good illustration of what can be done by an average owner in support of this conservation program.

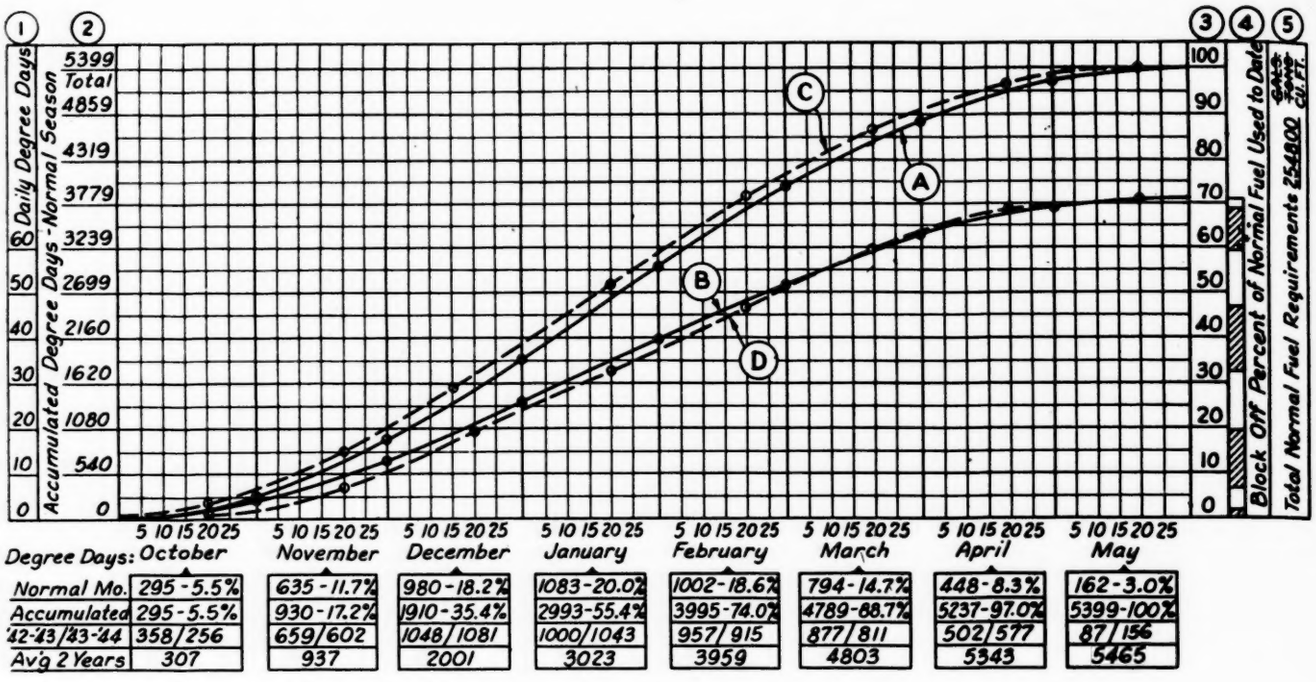
My home is a 9-room frame construction with attached garage and is well insulated throughout. The heating plant is a forced circulation warm air, gas-fired, Carrier-Lyle "Weathermaker" equipped with automatic humidity control. No apologies are offered for using gas because it is manufactured from bituminous coal. During the summer of 1942, the Public Service Electric and Gas Company suggested a variety of ways for saving gas-heating fuel, and asked the voluntary cooperation of its customers in effecting fuel savings, so that there might be no necessity for curtailment in the use of gas for domestic heating during the war. Back in 1936, condensation troubles on my windows at night and, during extremely cold weather, caused me to install storm windows throughout the first floor of my home, and now recognizing the wisdom of the Gas Company's suggestions, decision was made to install storm windows and doors throughout the entire house.

Normally, we carry an inside temperature of 72F from 7 a.m. to 11 p.m., with a minimum thermostat setting of 60F during the night. Usually a 3% saving is possible for each degree reduction in the inside temperature, so as a further savings measure the normal day-time temperature was reduced to 65F (16 hours) with no change being made in the night minimum.

Our next economy measure was the adoption of a firm policy of closing off all registers and doors in all bedrooms and other rooms in the house which were not in continuous use. These rooms usually stay around 60F because of damper leakage and radiation from adjacent rooms. My local fuel conservation plan was therefore (1) complete the installation of storm windows and doors for the entire

TABLE 1.—FUEL CONSUMPTION
(Hundred Cubic Feet)

Period	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	Totals	Cu Ft per D.D.	Percent Saving
Normal											
1933-34 to 1941-42	100	281	379	547	495	394	261	91	2548 (D.D. 5399)	47.2	Normal
Percent	3.9	11.0	14.9	21.5	19.4	15.5	10.2	3.6			
Savings											
1942-43	18	140	360	340	316	326	218	56	1774 (D.D. 5441)	32.6	30.9%
1943-44	30	144	288	372	350	340	254	56	1834 (D.D. 5488)	33.4	29.2%
2-Year Average	24	142	324	356	333	333	236	56	1804 (D.D. 5465)	33.0	30.1%
Percent	1.3	7.9	18.0	19.7	18.5	18.5	13.0	3.1	100%		



Fuel savings guide based on normal degree-days.

house (2) cut the day-time temperature 7F (3) cut off normal heating in all bedrooms and all other rooms not in use. A limited amount of data was then obtained to check the results.

Fuel consumption and degree-day data, Table 1, have been compiled for a 10-year period; the first 8 years were used to determine the normal fuel consumption, and the last two years were averaged to establish the fuel savings resulting from my conservation program. The heating season begins when the mean or average daily temperature continues below 65F—which in this locality is about October 1,

Degree Day Data Used

It is well recognized that degree days or heating degrees represent a practical measure of the amount of heat required during the heating season. The fuel savings guide has been developed, using degree days as a base, for distribution through retail distributors to consumers of bituminous coal. It is available for a number of cities in the United States on which corresponding weather data is printed and is equally suitable as a savings guide for consumers of coal, coke, oil, or gas. In order that one may visualize the accomplishments of my local conservation program, the results obtained have been plotted on the Fuel Savings Guide.

The scale shown in Column 2, on the above chart, is the standard normal degree day of the U. S. Weather Bureau for Newark, N. J. The total of 5,399 degree days is the normal for the heating season covering the period 1899 to 1941, inclusive. This average was practically the same as the 8-year period in which my normal fuel consumption was established, so that Graph *A* was plotted using the standard normal degree days.

In the first box below the graph, the normal degree days for each month are shown with the corresponding percentage of the total for the season. In the second box, the monthly degree days have been accumulated with the corresponding percentage of the total. Graph line *A* represents accumulated degree days using scale 2 and will read in percentage of total degree days, scale 3.

In the third box, the actual degree days for each month, for the years 1942-43 and 1943-44 have been shown and in the last box their average has been accumulated by months.

In carefully forecasting the probable fuel reduction resulting from my conservation program, a 30% saving was estimated. Graph *B* was therefore prepared on the chart as 70% of the average degree days for the two-year period. This graph with 30% less degree days now represents the new fuel line or goal of the savings program. Ordinarily, this line is plotted by adding a new segment each month, thus giving full consideration to current weather conditions.

Fuel Consumed Each Month

The normal fuel consumption percentage shown on Graph *C* is the actual average by months for the 8-year period (Table 1) with the total shown on Scale 5 of 254,800 cu ft. The gas meter was actually read on approximately the twentieth of each month and the comparison between Graph *A* (degree days) and Graph *C* (fuel consumption) shows very conclusively the close relationship between normal fuel required and normal degree days.

Graph *D* shows the monthly average fuel consumption for the two years after the savings program was inaugurated. It shows an actual accom-

plishment very much in line with the forecast. The normal *fuel consumption per degree day* for the 8 years was 254,800 divided by 5,399, equalling 47.2 (Table 1). The corresponding figure for the two years equals 180,400 divided by 5,465, equalling 33.0 cu ft per degree day, representing an actual saving of 30.2%.

Savings of this magnitude can be accomplished by any home owner in a variety of ways. It has always been my practice to use a wood fireplace during the chilly days of October and May, and that is the reason why my fuel consumption per degree day in these months is particularly low. In cooperation with the U. S. Conservation Program it is strongly recommended that the heating plant not be started before November 1st, and shut down not later than April 30th. Savings by so doing would be 8.5% of the total fuel required (October degree days 5.5%—May 3.0%) where the weather is comparable to that shown for Newark, N. J. Where the weather is more severe and the heating season is longer, it would be desirable to start the heating plant thirty days later than usual and shut it down thirty days earlier than normally, accomplishing approximately a 10% saving. It will be better to be a little uncomfortable during the early fall, thereby saving the fuel which is so essential during the severe days of winter.

Three years ago, when oil was first rationed, consumers who failed to insulate or institute other savings plans, endured a mighty uncomfortable winter. Last winter many anthracite customers lived from hand-to-mouth on domestic sizes, and this year the shortage will be worse than last. Now S.F.A.W. says all fuels, including bituminous coal, will be short this season and the safest thing we can do is to make our conservation plans accordingly for the season.

Simplified Practice in Industry

There is nothing about simplification that can arrest development in the art of designing superfine articles of any description. Indeed, employed sensibly, simplification should actually stimulate that development.

Simplification is not a preventive. It is exclusively a curative. An industry tries out everything in the way of design and, by trial and error, prospers. In the process, the industry becomes loaded down with varieties that, in the course of time, prove to have been ephemeral instead of classic. This litter of overdiversification could be swept aside, hurting no one and providing elbow room and a certain amount of released invested capital.

After this "sweeping" act, the industry can say to itself: "We have thrown overboard the deadwood. We have taken a specific action—step No. 1—in the direction of our ultimate objective."

At this point, let it be clearly understood that this discussion concerns varieties of a specific article that are produced for stock. It is not the intent and purpose of a simplified practice recommendation, and it never has been, to remove from the reach of users anything that they might need on special occasions. It is the intent and purpose to differentiate between:

(a) The sizes, types, and varieties which may be made in large quantities, for stock purposes, because of a known demand for them; and (b) those sizes, types, and varieties which cannot be produced in large quantities economically (because the demand is meager and sporadic) and which, if manufactured in tens of thousands instead of only in dozens, will run the risk of becoming expensive "shelf-warmers."

In continuation from step No. 1, described above, the industry might prolong its reasoning about as follows: "What shall we do in step No. 2, for we are not going to stand still? Let us fasten our attention on the varieties that survived our action in step No. 1, and try to make the retained items better instead of only different."

Having accomplished step No. 2, the industry is in position to say to itself: "Now we are ready for step No. 3. We have cleaned out the dead wood. We have made the retained items *better.*" It also may find itself in a position to say: "We have discovered that we must *increase* the sizes, types, and varieties to a number that totals as many as, if not more than, we had before we took step No. 1. We believe that this is progress, not retrogression, because we are substantially aiding every industry, every individual worker, and every individual craftsman to do their specialized jobs better, by placing at their disposal the right article for their use. We have rid ourselves of nonessentials, and the development of the art of designing our products has been given a stimulant."

In the course of time nonessential varieties would show their parasitic heads again, and the above-described cycle of events or curative process would recur. In other words, a simplified practice recommendation that had emerged from step No. 1 would be ready for revision. The standing committee of representative manufacturers, distributors, and users in whose care the maintenance of the recommendation had been placed would be the best judge as to the timing of such a revision.

Under the recognized peacetime procedure of the Division of Simplified Practice there have been developed more than 200 Simplified Practice Recommendations, many of which have been revised several times. One of them has been reviewed annually since 1922, and revised 10 times. Industry should investigate the possibilities and benefits to be obtained from organizing such a program.—*Abstracted from an article in "Domestic Commerce," March, 1944, Edwin W. Ely, Chief, Division of Simplified Practice, National Bureau of Standards, Washington 25, D. C.*

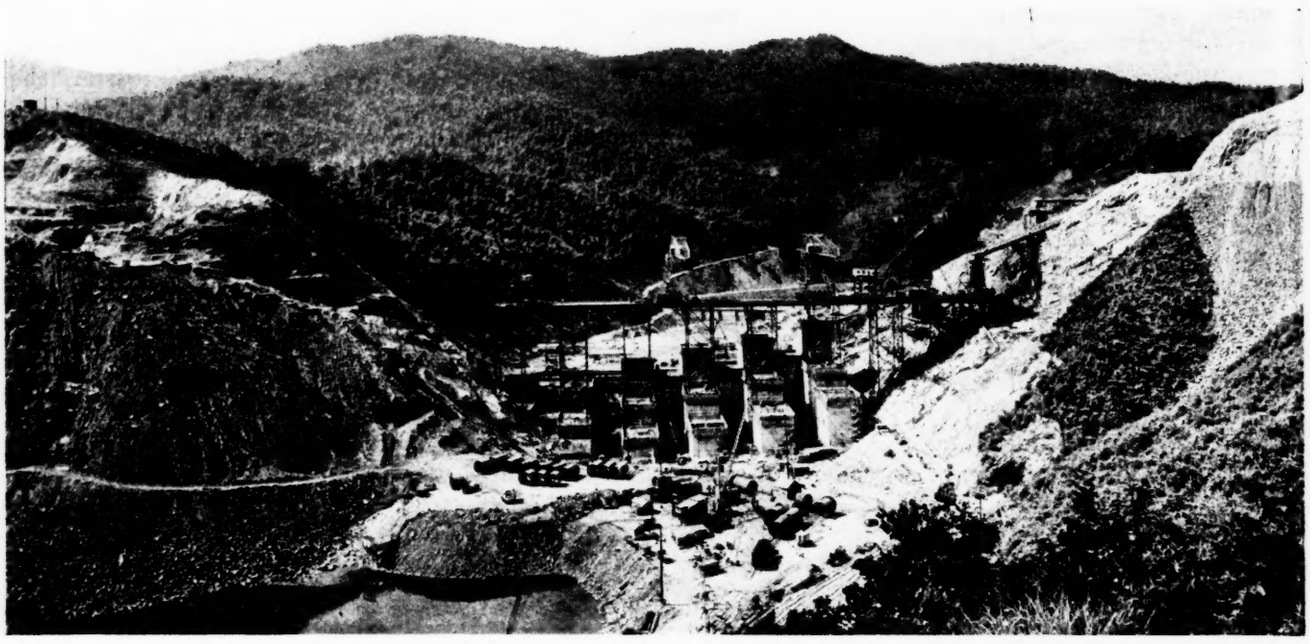


Fig. 5. Fontana Dam looking down stream, showing 350,000 cu yd of concrete in place.

Refrigeration in Dam Construction

W. R. WAUGH

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THE concrete cooling facilities consist of two plants which operate as separate units. One of the plants is a mechanical refrigeration plant, called the refrigerated water plant, and it supplies a limited amount of water at controlled and regulated temperatures. The other plant, the river water plant, supplies a much larger quantity of water pumped directly from the river at temperatures which vary throughout the year with the changing seasonal temperature. The cooling done by the two plants is roughly in the proportion of one-fourth by the refrigerated water plant and three-fourths by the other.

The refrigeration plant is an ammonia plant with the usual components, including two compressors, condenser, receiver, water cooler, chilled water pump, chilled water surge tank, and the necessary controls, valves and piping. Compressors are multicylinder, reciprocating, single-acting ammonia units with capacities of 195 and 60 tons per day, respectively. They are operated as a unit and have a feature which the manufacturer calls "step capacity reduction control," which allows the plant to adjust itself automatically to loads of 36, 60, 114, 152, 190, 226, and 250 tons, as required. Every effort is bent to keep the plant operating at full load.

The condenser is a horizontal, enclosed shell and tube type, 38 in. diameter by 16 ft long with 426 tubes of 1¼ in. o.d. The ammonia receiver is a horizontal cylinder 24 in. in diameter and 12 ft long. Condensing water is pumped directly from the river by a 2-stage, 1,000 gpm vertical centrifugal pump.

The method of operation utilizes the lowest possible ammonia level in the cooler to lessen the danger of "freeze up," and this also reduces the size of the charge. An ammonia pump keeps all the tubes wetted by circulating the ammonia through spray headers. The manufacturer claims that this prevents slugs of liquid from returning to the compressor and permits higher suction pressure to obtain minimum temperature split between the ammonia and water temperatures.

Water to be cooled is drawn from the warm end of a chilled water surge tank and pumped through the cooler and back to the cold end of the surge tank by means of a 1200 gpm horizontal centrifugal pump. The chilled water surge tank has a water level capacity of about 2,700 gallons and is usually held at a level equivalent of 2,200 gallons. The tank has a bulkhead and adjustable weir which regulates the flow of excess cold water from the cold end to the chilled water circulating pump suction and also prevents the hot water from surging over into the cold end of the tank. Fig. 6 shows the schematic arrangement of the cooling plants. Note that supply, return, and circulating piping are ar-

Part 1, describing the arrangement of cooling coils, the procedure for cooling the concrete, and the water connections necessary, appeared in the August, 1944, issue.

ranged to get coldest possible water into the cooling system.

Cold water is supplied to coils in the concrete through a system of two 6-inch mains which connect the refrigeration plant with 6 in. laterals on the dam faces. Laterals extend the entire length of the cooled part of the dam. Extending up and down at every other transverse contraction joint, are two 3 in. risers to serve the coils in the two adjacent blocks. On each riser, spaced conveniently, are outlets to which are attached manifolds from which connections are made to the individual coils. One of the mains serves as a supply and the other as a return, and arrangements for reversing the flow are provided between the pumps and the coils. Thus each pipe serves alternately as supply and return. Once each week the flow is reversed in the distribution systems and, consequently, in the coils. This is done to insure uniform cooling throughout each block.

Water is pumped by four horizontal centrifugal pumps arranged in tandems of two pumps each. The pumps have a rated capacity of 300 gpm at 200 ft head. The two sets of tandems working together can supply 600 gpm at 4 ft head. The maximum static head against which the pumps will have to work is 345 ft. Regulation of the plant tonnage has been achieved partly by varying the gpm through the pumps to utilize full capacity of the plant at all times as far as possible. The number of coils in operation is also varied with changes in temperature of the concrete being cooled to maintain full operating capacity.

In practice, the amount of water pumped has

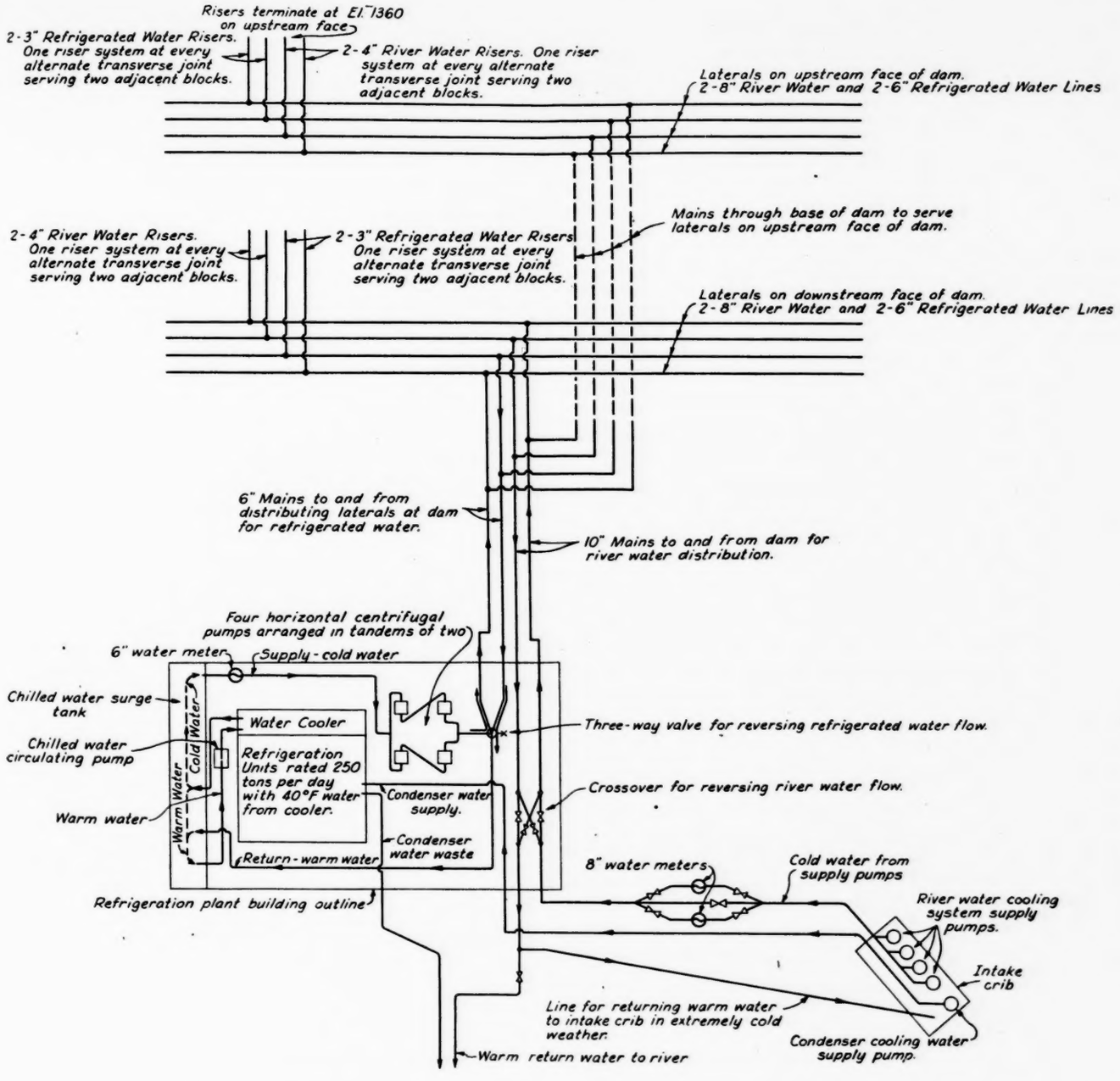
Risers terminate at El. 1360 on upstream face
2-3" Refrigerated Water Risers. One riser system at every alternate transverse joint serving two adjacent blocks.
2-4" River Water Risers. One riser system at every alternate transverse joint serving two adjacent blocks.
Laterals on upstream face of dam. 2-8" River Water and 2-6" Refrigerated Water Lines
Mains through base of dam to serve laterals on upstream face of dam.
2-4" River Water Risers. One riser system at every alternate transverse joint serving two adjacent blocks.
2-3" Refrigerated Water Risers. One riser system at every alternate transverse joint serving two adjacent blocks.
Laterals on downstream face of dam. 2-8" River Water and 2-6" Refrigerated Water Lines
6" Mains to and from distributing laterals at dam for refrigerated water.
10" Mains to and from dam for river water distribution.
Four horizontal centrifugal pumps arranged in tandems of two
6" water meter
Supply - cold water
Chilled water surge tank
Chilled water circulating pump
Water Cooler
Refrigeration Units rated 250 tons per day with 40°F water from cooler.
Cold Water
Warm Water
Warm water
Three-way valve for reversing refrigerated water flow.
Crossover for reversing river water flow.
Condenser water supply.
Condenser water waste
Return - warm water
8" water meters
Cold water from supply pumps
River water cooling system supply pumps.
Intake crib
Refrigeration plant building outline
Line for returning warm water to intake crib in extremely cold weather.
Condenser cooling water supply pump.
Warm return water to river

Fig. 6. Schematic arrangement of plant and piping for cooling the concrete.

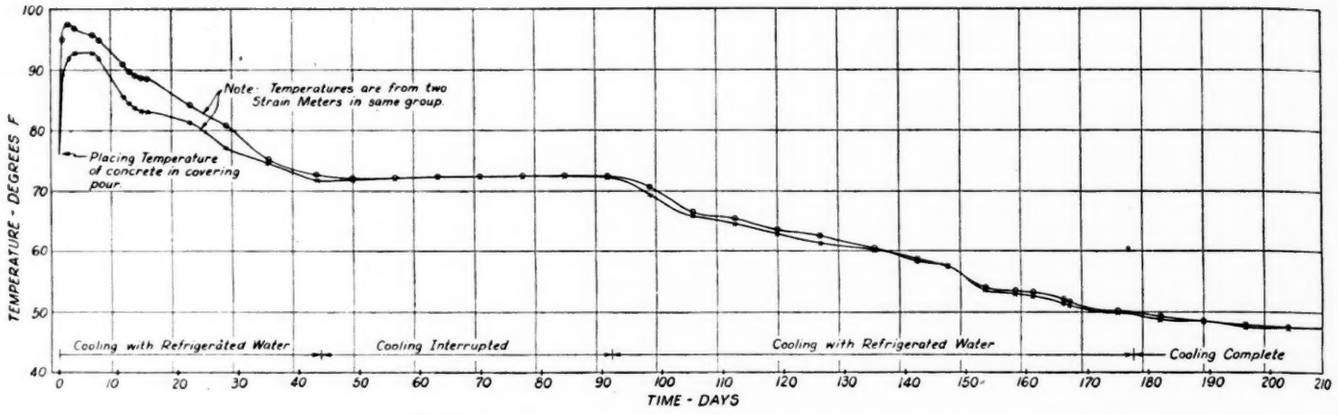
Note: Temperatures are from two Strain Meters in same group
Placing Temperature of concrete in covering pour
Cooling with Refrigerated Water
Cooling Interrupted
Cooling with Refrigerated Water
Cooling Complete
TEMPERATURE - DEGREES F
TIME - DAYS

Fig. 7. Typical time-temperature curves for the embedded instruments. Cooling pipe spacing 2.5 ft; lift thickness 2.5 ft.

varied from about 500 gpm to as high as 850 gpm, with from 110 to 175 coils in operation. Normally the plant is operated at about 250 tons gross refrigeration, with water from the cooler at about 40F. It has been found profitable at times to increase the quantity of water being pumped, with resulting increases in temperature of water from the cooler, and consequent increases in tonnage.

During the summer of 1943, when concrete was predominantly in zone 1, gross tonnage was maintained at from 300 to 325 tons per day for an extended period of time. Water from the cooler for this period was usually in the range of 50 to 55F. A 6 in. turbine-type water meter is provided in the suction line between the surge tank and the pumps for measuring the quantity of water being pumped.

The distribution system is ordinarily operated as a closed system, with all the warm water from the coils being returned to the plant for reuse. It was found profitable, however, in the winter of 1943-44 to waste the return water and add cold make-up water from the river when the river water was cooler than the returning water.

River water for cooling is distributed through a set of two 10 in. mains which serve 8 in. laterals on the faces of the dam and is identical in arrangement to the refrigerated water distribution system. The two 10 in. mains serve alternately as supply and return mains. A crossover (Fig. 2, August, 1944) is provided for reversing the flow, which is done once a week, just as in the case of the refrigerated water. The pumping station is located on a timber crib on the downstream side of the downstream cofferdam adjacent to the main diversion tunnels. The plant includes three vertical centrifugal pumps rated at 1,100 gpm for a head of 250 ft and one 2,000 gpm pump at 200 ft head. One of these pumps is usually a standby, but last winter all pumps were used simultaneously to get maximum use of cold river water.

Also located on the crib is a two-stage 1,000 gpm vertical centrifugal pump which supplies cooling water to the refrigeration plant condenser exclusively. Warm water returning from the dam after passing through the coils is usually wasted in the river downstream from the intake crib. Arrangements are provided, however, for returning some of the warm water to the pump crib in extremely cold weather to raise the temperature of the water as a safety measure against freeze-up at the manifolds. Water in the river has varied during this operation from a high of 81F in August, 1943, to a low of 33F in February, 1944. The temperature of water going to the dam has not been allowed to go below 35F.

Field Control Procedure

Provisions are made for checking and controlling the progress of the cooling. In three selected blocks of the dam, embedded instruments are placed for measuring internal temperatures and checking the structural behavior of the dam. Four different kinds of instruments are included, all of which utilize the electrical resistance principle in one or both of two ways for indicating temperature or structural change. The four kinds of instruments are as follows: the Carlson resistance thermometer for temperature measurement only; Carlson strain meter for measuring both temperature and strains; Carlson stress meter for measuring both temperature and compressive stress, and Carlson joint meter for measuring both temperature and contraction joint opening. These instruments are made by Professor Roy W. Carlson of the University of California.

Interior concrete temperatures are measured by inserting portable thermometers into pipes embedded in the concrete for this purpose. The pipes are placed in the center of a layer of concrete approximately halfway between layers of cooling coils. They are generally placed in all even numbered blocks at intervals of 25 ft vertically on the downstream side of the dam and in selected locations on the upstream side and in galleries.

Data collected from the portable and embedded instruments serve as the principal controls of the cooling operation. In addition to these checks, inspectors make routine checks of all the operations incident to the cooling, and keep records of the operation. They check flows on individual coils, make various types of cooling water temperature

check, and regulate the use of refrigerated water by adding coils as required to keep the plant at maximum load. The flow checks on individual coils serve as a basis for regulating the distribution of water as nearly uniformly as possible over the system.

In locations where no embedded or portable temperature measuring devices are available, inspectors determine the approximate average concrete temperatures by means of static water temperature checks. When there is evidence that cooling is complete in any location, the circulation of water in the coils is discontinued, and when the water is stopped, precautions are taken to leave the coil filled with water.

After sufficient time for redistribution of the remaining heat has elapsed, and concrete temperatures around the coil in question have become reasonably uniform, the check is made. This is accomplished by forcing out the water left in the coil by displacement and measuring the temperature of the water as it is discharged. This method of checking concrete temperatures has given remarkably close results when compared with temperatures from embedded and portable instruments, where opportunity for comparison has occurred. A large number of comparisons has been made as a basis for evaluating the reliability of this method, and there seems to be evidence that temperatures determined in this manner are not in error by more than 3F plus or minus, under most circumstances.

Field Experience

Complete achievement of all objectives in this type of program is a desirable goal which is rarely, if ever, reached even under construction schedules of normal times. Under a forced draft schedule adopted to meet war conditions, it is harder to approach reasonable success. The achievement of objectives on this project to date has been all that could be expected under existing circumstances. The dam is still under construction and at this writing is 80% complete.

There is no evidence at present which would indicate that any serious cracking has occurred in the restrained zone at the base of the dam, where cooling was intended to keep temperature rise within safe limits. Very few cracks have occurred, and, in all cases, they have been of exceedingly minor significance. Control of tilting in side hill blocks has been successful in almost all cases. Cooling to final stable temperatures has been reasonably successful up to now. Actual temperatures achieved are within the range of 5F above or below estimated desired temperature in most locations.

Gross refrigeration tonnage has been maintained at very high rates. The plant has equalled the manufacturer's guaranteed tonnage at all times except at the beginning. In this instance, the manufacturer's engineer found the difficulty and corrected it in a very short time. Net tonnage has been slightly less than anticipated due to heat picked up on exposed lines to and from the dam. In this summer's operation, all mains and laterals will be insulated to increase net refrigeration. Pump capacities have been adequate up to the present time. Some difficulties may yet develop in getting adequate flow in coils near the very top of the cooled section.

Acknowledgments

When the project was started, C. E. Blee was Project Manager. Since then, Mr. Blee succeeded the late Col. Theodore B. Parker as Chief Engineer when Colonel Parker resigned to become Head of the Department of Civil and Sanitary Engineering at M.I.T. At the project now F. C. Schlemmer is Project Manager, Oren Reed is Construction Engineer, and G. E. Murphey is Construction Superintendent.

George R. Rich is Chief Design Engineer. All design for temperature stresses and all design work related to the cooling problem was done in the Civil Design Department under direction of Adolph A. Meyer, Head Civil Design Engineer, and Ross M. Riegel, Head Civil Engineer on the technical staff. Under Mr. Meyer, all cooling studies and design details were supervised by George P. Palo, Senior Civil Engineer.

B-29 Nose Insulated for Heat and Exfiltration

The nose section and certain other portions of the Boeing B-29 Superfortress fuselage are protected against cold, heat and the atmospheric pressure of high altitudes. This means that the B-29 is the first combat bomber in which a comfortable air pressure condition can be maintained over long periods of time, while the plane flies at high stratosphere altitudes, according to technicians of the DeSoto Division, Chrysler Corporation, which manufactures and assembles the nose of this country's newest air weapon.

To achieve this comfortable air-conditioned effect, two things are necessary: The cabin must be sealed so no air can get in or out of it except by pumps; and there must be a series of pumps which keep the air pressure and temperature inside the cabin at a constant level even though the ship may rise into high altitudes where the temperature and pressure are very low.

The job of sealing the nose section calls for an intricate and complex treatment whereby every seam, joint and every one of the thousands of rivets must be sealed by gummed tapes, putties and sealing compounds. Even repair rivets must be dipped in sealing compound and dried before installation in the unit. This is entirely a hand operation requiring many man-hours of labor since the nose section comprises more than 16% of the entire craft.

Oil Piping—Its Design and Application

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FUEL oil has long been used for heating furnaces in steel mills, foundries, and forge plants, for industrial and domestic boilers, space heaters when steam is not available, and so on. The purpose of this article is to explore the various types of equipment employed in the mechanical handling of fuel oils and endeavor to point out the important factors in the design of such systems. The mechanical handling systems are similar for fuel oil and quench oil installations, and may be likewise used for many other liquids having similar characteristics.

Fuel Oil Characteristics

Since nearly any oil which can be made to burn might be called a fuel oil, it is expedient that we define the term as applied to commercial oils. Fuel oil is defined by the American Society for Testing Materials (A.S.T.M., D288-31T) as any liquid or liquefied petroleum product burned for the generation of heat in an industrial or household furnace or firebox, or for the generation of power in a diesel engine, exclusive of oils with a flash point below 100F. Gasoline, kerosene, and lubricating oils are therefore excluded by this definition. There are two main types of crude petroleum: (1) paraffin-base, and (2) asphaltic-base. Probably the greater portion of fuel oils comes from the asphaltic-base crude since the paraffin-base oils yield an extremely high percentage of gasoline and distillate oils. This relationship can be modified by the hydrogenation process which consists of adding free hydrogen in the presence of a catalyst during certain phases of the refining process.

Fuel oil can be divided into two general groups: (1) distillate or light fuel oil, and (2) residual or heavy fuel oils—the latter rarely being used for domestic applications because of the difficulty of handling. The U. S. Department of Commerce has established standards for fuel oils, to which most of the refineries adhere or produce fuel oils that can be similarly classified. Table 1 gives some properties of these six grades of fuel oils.

In order further to identify these oils, the A.P.I. gravity and specific gravity columns have been added to Table 1. These factors do not appear in the "Detailed requirements for fuel oils" as contained in commercial Standard Specification CS 12-40. As a result of a general demand by the oil industry for a reduction in the number of grades of fuel oils to be stocked by refiners and distributors, these specifications were revised in 1938 to eliminate Grade 4. For continuity and reference, we have included in the table the requirements for No. 4 oil as given in Commercial Standard CS 12-35. It may be of value to define the characteristics of oils so that their importance will be more clearly understood when we take up the subject of piping system design.

Flash Point—The flash point of an oil is the temperature at which vaporization occurs at a rate which will produce an inflammable mixture with air. A flame applied to the vapor at this temperature will cause it to ignite momentarily. It is apparent that the space above the oil will have a definite bearing upon the formation of the inflammable mixture. It is therefore essential when stating the temperature at which flashing will occur to also state the apparatus and procedure employed. In Specification CS 12-40, the closed cup or Pensky-Martens test was used. The minimum flash point of oils used for fuel is usually specified by law; however, when there are no legal requirements, the minimum values in Table 1 are employed. The maximum values for Grades 1, 2 and 3 are specified to insure required ease of ignition.

If an open cup (Cleveland test) of oil is continually heated beyond the flash point, a temperature will be reached at which vapors are driven off at so rapid a rate that continuous burning will result if a flame is applied to the vapor-air mixture. This temperature is known as the fire point. Ordinarily an oil heated above the flash point is a distinct hazard, but there are times when so doing is necessary and it is then that the fire point is the controlling factor. Such cases usually occur in closed systems where the possibility of creating an inflammable mixture with air is negligible.

Pour Point—The A.S.T.M. definition of this characteristic states that it is the lowest temperature at which the oil will flow when cooled and tested under prescribed conditions. The pour point specifications are of value in securing oils which will not cause difficulty in handling or in use at the lowest temperatures to which they may be normally subjected. The importance of a low pour point is at once recognized in the case of light oils or distillates used in domestic installations where preheating is undesirable.

Viscosity—The viscosity of a fluid is measured by the time required in seconds to pass a predetermined quantity through a tube of specified dimensions. The Saybolt universal and Saybolt furol viscosimeters are most generally used in the United States, while the Engler and Redwood instruments are favored in Europe. For light oils, such as Grades 1, 2, 3 and 4 fuel oils, the Saybolt universal time in seconds at 100F is used; whereas for heavier oils a larger tube is required and therefore the viscosity is determined

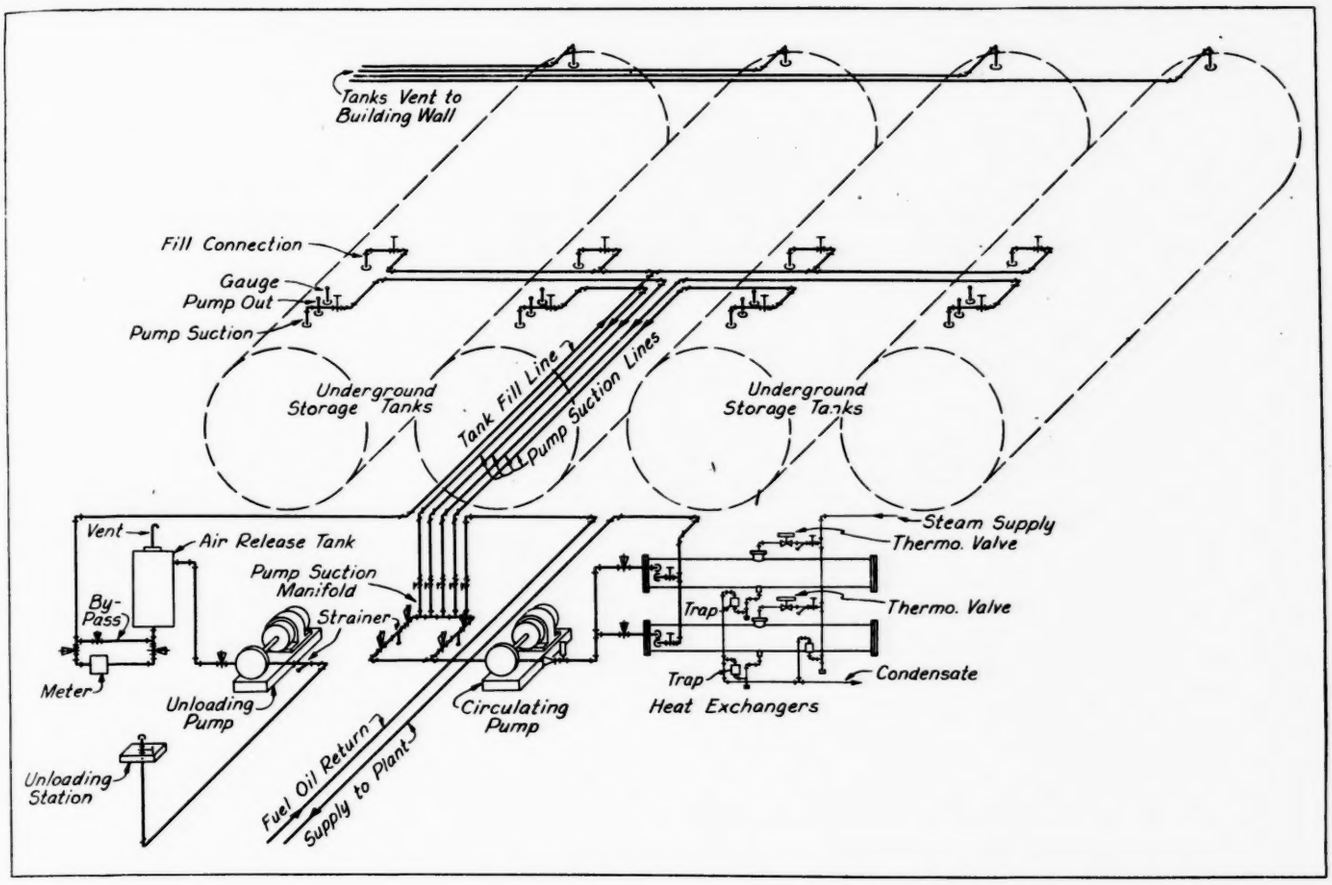


Fig. 1. Schematic drawing showing a fuel oil storage and delivery system for a heavy oil requiring preheating.

at 122F in the Saybolt furol viscosimeter. There are varied definitions of viscosity, but all indicate that it is the measure of a liquid's resistance to flow. In this respect, viscosity is related to the pour point of a liquid. By definition, the pour point is the lowest temperature at which the liquid will flow. However, the viscosity at this temperature may be so high that handling of oils in pipe lines, pumps and other equipment becomes impractical. For this reason, maximum pour point temperatures are specified in the standards for the light grades of fuel oil.

The importance of viscosity in the design of oil storage and handling systems, and in the selection of burners cannot be over-emphasized. Viscosity decreases with rising temperature, and it is this characteristic which has enabled the industrial use of viscous, low grade oils. The relationship of viscosity to temperature for a given oil is as definite as the pressure-temperature relationship for saturated steam. The maximum viscosity of fuel oils for pumping has been given as high as 10,000 Saybolt Universal seconds (S.U.S.) but 3,000 S.U.S. for short runs and under 1,000 S.U.S. for factory distribution systems is more practical as pipe sizes are smaller and horsepower is reduced. For oil burners, the A.S.T.M. tentative Standard D 341-32 T gives a viscosity range of 100-200 S.U.S. The type of atomization and pressures involved have a definite bearing on the selection of the proper viscosity. With low pressure air, the viscosity required may be at the lower limit, while with high pressure oil over 100 P.S.I., the viscosity may be 150-200 S.U.S., and in some cases even higher. Since many purchasing departments have a habit of buying fuel oil on a price basis, *it is good practice to design the distribution system and select the burners with the idea in mind that at some future date a heavier oil may be used than was originally specified.*

Specific Gravity — Next to viscosity, the specific gravity is probably the most important characteristic of fuel oils; in fact, for many years classification of fuel oils was based almost entirely on "gravity." The general definition of specific gravity is the ratio of the weight of a given volume of oil at 60F to the weight of an equal volume of pure water at the same temperature. Because the decimal expression of specific gravity for various oils is difficult to remember for ready reference, the Baume scale was used by the oil industry for many years. However, since two scales were used—one for liquids lighter than water, and one for liquids heavier than water—it was always necessary to specify which scale was being used. As an example:

	Baume	Sp. Gr.	Wt., Lb. per Gal.
Liquids lighter than water ...	10	1.000	8.33
Liquids heavier than water ...	10	1.074	8.95

Consequently, the American Petroleum Institute, together with the U. S. Bureau of Mines and the U. S.

TABLE 1.—COMMERCIAL STANDARD SPECIFICATIONS FOR FUEL OILS

(Commercial Standard CS12-40; A.S.T.M. designation D396-39T.)

Spec. No.	Grade of Oil	Gravity, A.P.I.	Average Sp. Gr.	Flash Point, F	Pour Point		Maximum Viscosity		
					Max., F	Min., F	S.U.S.	S.F.S.	F
1	Distillate oil for use in burners requiring a volatile fuel	48-39	0.810	110-165 or legal	0	—	—	—	—
2	Distillate oil for use in burners requiring a moderately volatile fuel	36-32	0.855	110-190 or legal	10	0	—	—	—
3	Distillate oil for use in burners requiring a low viscosity fuel	32-28	0.876	110-230 or legal	20	0	45	—	100
4*	An oil for use in burners requiring a low viscosity fuel	28-24	0.898	150-	—	15	500	—	100
5	Oil for use in burners requiring a medium viscosity fuel	24-18	0.928	130- or legal	—	—	—	40	122
6	Oil for use in burners with preheaters, permitting a high viscosity fuel	18-12	0.966	150-	—	—	—	300	122

*Commercial Standard CS12-35.

Bureau of Standards, agreed in 1921 to recommend that only the scale based on the modulus 141.5 be used. The so-called A.P.I. scale was subsequently adopted and has nearly supplanted the old two-scale Baume index. Both the Baume and A.P.I. scales are merely arbitrary means of classifying fuel oils since they cannot be used in calculations. Their value lies mainly in the fact that the various specific gravities are expressed in whole numbers instead of decimal fractions. Readings on the A.P.I. hydrometer are converted to specific gravity by the following relationship:

$$\text{Specific gravity} = \frac{141.5}{\text{Degrees A.P.I.} + 131.5}$$

Mechanical Handling Equipment

The storage and distribution of fuel oils, as well as other liquids, requires careful analysis of the requirements and detailed study of all the factors involved. Although fuel oils are not classed as "flammable liquids," nevertheless great care must be exercised in the location of the storage facilities and the safeguards installed. The National Board of Fire Underwriters have established so-called minimum requirements for the safeguarding of life and property against loss by fire. So important is this subject that we feel an efficiently designed system, insofar as tanks, pumps, heaters and piping are concerned, is far from being a well-engineered system unless it embodies practical safeguards to prevent the system from being a hazard to the plant and adjoining property, and a menace to the men whose duty is to operate the equipment.

Fig. 1 illustrates schematically a fuel oil storage and delivery system for a heavy oil requiring heating. Single pumps are shown for unloading and delivery, but duplicate circulating pumps should always be provided to insure against a shut-down during servicing periods. A system for a low viscosity oil would be identical with the exception of the preheaters. Referring to the schematic diagram, the several components of the system will be described with particular reference to the N.B.F.U. minimum requirements for storage tanks and safety controls.

Storage Facilities—There are two methods of storing fuel oils: (1) In vented tanks, and (2) in hydraulic tanks. Above or below the ground vented tanks are customary, although the hydraulic system has been frequently used where the storage and distribution of oils has been in conjunction with aviation gasoline handling systems. This method of storing and distributing liquids which are not soluble in water will be discussed in a later article. The present discussion will therefore be confined to vented storage tanks.

Since fuel oil storage systems are usually installed so as to conform to the National Board of Fire Underwriters Standards, it seems logical that direct excerpts from these standards will best describe good practice to follow for such installations.

N.B.F.U. Standards for Fuel Oil Tanks

1. Application and Scope

(a) These standards apply to oil-burning equipments for installation in furnaces and boilers used for heating dwellings and for various commercial and industrial applications.

(c) Where the circumstances or conditions of any particular installation are unusual and such as to render the strict application of these standards impracticable, the inspection department having jurisdiction may permit such modifications as will provide a substantially equivalent degree of safety.

7. Installation of Underground Tanks

(a) Oil supply tanks should preferably be located outside of buildings and underground with top of tank below the level of all piping to which the tank is connected, to prevent discharge of oil through a broken pipe or connection by syphoning.

(b) Underground tanks shall be so buried as to have a cover of earth not less than two feet, or shall be covered with not less than one foot of earth on top of which shall be placed a slab of reinforced concrete not less than 4 inches thick. The slab shall be set on a firm, well tamped earth foundation and shall extend at least one foot beyond the tank in all directions. Where tanks are buried underneath buildings, such a concrete slab shall be provided in every instance.

8. Installation of Tanks Inside Buildings

(a) Oil supply tanks larger than 60 gallons capacity shall not be located in buildings above lowest story, cellar or basement.

(b) Unenclosed inside storage tanks and auxiliary tanks shall not be located within seven feet, horizontally, of any fire or flame.

(c) Oil supply tanks located inside buildings shall not exceed 275 gallons individual capacity or 550 gallons aggregate capacity (in one building) unless installed in an enclosure or casing constructed as follows:

The walls of the enclosure shall be constructed of reinforced concrete at least 6 inches thick or of brick at least 8 inches thick, and shall be bonded to the floor. The space between the tank and the enclosure shall be completely filled with sand or well tamped earth. Where the floor or other construction immediately above the tank is of fire-resistive construction capable of safely sustaining a load of 150 lb per square foot, the walls of the enclosure shall be carried to a height not less than one foot above the tank and the space filled with sand or well tamped earth to the top; otherwise, the enclosure shall have a top of reinforced concrete at least 5 inches thick or of equivalent construction.

Instead of an enclosure as above described, the tank may be encased in reinforced concrete not less than 6 inches in thickness, applied directly to the tank so as to completely eliminate any air space.

(d) In ordinary buildings the nominal gross capacity of the tanks shall not exceed 5,000 gallons.

(e) In fire-resistive buildings the nominal gross capacity of the tanks shall not exceed 15,000 gallons.

(f) In any building, if in a fire-resistive or detached room cut off vertically and horizontally in an approved manner, from other floors of the main building, the nominal gross capacity of tanks shall not exceed 50,000 gallons, with an individual tank capacity not exceeding 25,000 gallons.

9. Installation of Outside Above Ground Tanks

(a) Outside above ground tanks shall not be located in closely built-up areas.

(b) The distance from outside above ground tanks to line of adjoining property or nearest building shall not be less than set forth in the table below:

Capacity of Tanks, Gallons	Minimum Distance, Feet	Capacity of Tanks, Gallons	Minimum Distance, Feet
750 or less	5	128,000 or less	75
1,100 or less	10	200,000 or less	85
3,000 or less	20	266,000 or less	100
21,000 or less	25	400,000 or less	150
31,000 or less	30	666,000 or less	250
45,000 or less	40	1,333,000 or less	300
64,000 or less	50	2,666,000 or less	350
80,000 or less	60		

(c) For tanks of over 400,000 gallons capacity, a minimum distance of 175 feet to adjoining property or nearest building may be permitted, provided that an approved type of fire extinguishing system is installed for the tank and covering other parts of the yard or system.

(d) For tanks permitted from 50 feet and up to 175 feet of a building or property line, the capacity may be increased 33 per cent if the tank is provided with an approved fire extinguishing system.

(e) The minimum distance from tanks to adjacent tanks shall conform to the following table:

Capacity of Tank, Gallons	Minimum Distance to Any Other Tank, Feet
18,000 or less	3 feet
24,000 or less	5 feet
48,000 or less	10 feet
75,000 or less	13 feet
100,000 or less	15 feet
100,000 to 2,500,000	One Tank Diameter

(f) Tanks shall be so located as to avoid possible danger from high water. When tanks are located on a stream without tide, they shall, where possible, be downstream from burnable property.

(g) Embankments or Dikes—In locations where above ground tanks are liable in case of breakage or overflow to endanger surrounding property, each tank shall be protected by an embankment or dike. Embankments or dikes shall be made of clay-core cinder-fill, earthwork, masonry or approved concrete. Such dikes shall have a capacity of not less than that of the tank or tanks surrounded. Earthwork embankments shall be firmly and compactly built of good earth from which stones, vegetable matter, etc., have been removed, and shall have a flat section at the top of not less than three feet and a slope of at least 1½ to 1 on both sides. Small tanks with capacities of not over 25,000 gallons each may be grouped and a dike built around the group of tanks.

Embankments or dikes shall be continuous with no openings for piping or roadways. Piping should preferably be laid over or under embankments.

10. Setting of Tanks

(a) Underground tanks shall be set on a firm foundation and surrounded with soft earth or sand well tamped in place. Where necessary to prevent floating, they shall be securely anchored or weighted.

(b) Inside storage and auxiliary tanks shall be securely supported by substantial incombustible supports to prevent settling, sliding or lifting.

(c) It is recommended that inside storage tanks be provided with draw-off or drain openings. When draw-off or drain openings are provided the tanks shall be installed with the bottom pitched to the draw-off or drain opening with a slope of not less than ¼ inch per foot of length. The draw-off or drain opening shall be provided with suitable pipe connections in a form to provide a sump from which water or sediment can be readily drained at regular intervals.

(d) Outside above ground tanks shall be set on a firm foundation. Those more than one foot above the ground shall have supports of masonry or protected steel, except that wooden cushions may be used. No combustible material shall be stored under or within ten feet of outside above ground tanks.

11. Construction of Tanks

(a) Underground tanks and tanks inside buildings shall be constructed of steel or wrought iron of a minimum thickness gauge (U. S. Standard) in accordance with the following table, except that for tanks of 181 to 275 gallons capacity, installed in buildings, and without masonry enclosures the minimum gauge shall be No. 14. Steel or wrought iron thinner than No. 7 gauge used in the construction of underground and enclosed tanks shall be galvanized.

Capacity, Gallons	Minimum Thickness	Weight, Lb. per Sq. Ft.
7 to 285	16 gauge	2.50
286 to 560	14 gauge	3.125
561 to 1,100	12 gauge	4.375
1,101 to 4,000	7 gauge	7.50
4,001 to 12,000	1/4 inch (nominal)	10.00
12,001 to 20,000	5/16 inch (nominal)	12.50
20,001 to 30,000	3/8 inch (nominal)	15.00

If adequate internal bracing is provided, tanks of 12,001 to 30,000 gallons capacity may be built of ¼ inch plate.

Note—For tanks larger than 1,100 gallons capacity, a tolerance of 10 per cent in capacity is permitted.

(b) Outside above ground tanks, including tops, shall be constructed of steel or wrought iron of a thickness in accordance with the following requirements:

1.—Horizontal or Vertical Tanks Not Over 1,100 Gallons Capacity

Capacity, Gallons	Minimum Thickness of Material
1 to 60	18 gauge U.S. Standard
61 to 350	16 gauge U.S. Standard
351 to 560	14 gauge U.S. Standard
561 to 1,100	12 gauge U.S. Standard

2. Horizontal Tanks Over 1,100 Gallons Capacity

Tanks having a diameter of not over 6 feet shall be made of at least 3/16 inch steel or wrought iron.

Tanks having a diameter of over 6 feet and less than 11½ feet shall be of at least ¼ inch steel or wrought iron.

3. Vertical Tanks Over 1,100 Gallons Capacity

The minimum thickness of shell or bottom shall be 3/16 inch. The minimum thickness of roof shall be ⅛ inch.

The thickness of shell plates shall be in accordance with the following formula:

$$t = \frac{H \times D}{8450 \times E}$$

where t = thickness of plate in inches,
H = height of tank in feet above the bottom of the ring under consideration,
D = diameter of tank in feet,
E = efficiency of vertical joint in ring under consideration.

In computing the efficiency of vertical joints the tensile strength of steel shall be taken as 55,000 lb. per square inch, and the shearing strength of rivets, 40,000 lb. per square inch.

Note—Vertical steel tanks with riveted shells constructed in accordance with American Petroleum Institute Standard No. 12-A may be considered as meeting the above requirements.

(c) Joints shall be riveted and caulked, brazed, welded or made tight by some equally satisfactory process. Tanks shall be tight and sufficiently strong to bear without injury the most severe strains to which they may be subjected in practice. Shells of tanks shall be properly reinforced where connections are made. All connections to storage tanks other than outside above ground storage tanks, shall be made through the top of the tank above the liquid level, except that tanks of not over 275 gallons capacity may have one bottom connection for gravity feed and one opening for an approved key stem gate valve to facilitate cleaning or for a scavenging line to be run to the outside and capped oil tight when not in use.

Note—While correct design and use of proper materials are essential regardless of the type of construction employed, where tanks are welded the safeness and suitability of the completed container for the purpose intended will also depend upon the skill and competence of the welder.

The foregoing N.B.F.U. standards are for fuel oils having flash points of not less than 100 degrees F as determined by the Pensky-Martens closed tester in accordance with the method of test adopted by the American Society for Testing Materials (D93-42).

There is a general agreement that steel tanks for fuel oil storage are preferred; however, due to the critical steel situation during the early war years, a number of concrete storage reservoirs have been constructed. Reinforcing steel has been used in the concrete as well as in the form of bands around cylindrical tanks—the bands being held together by turnbuckles. In the so-called prestressed type of construction, the bands are given an initial stress before the tanks are poured. Concrete construction, when necessary, should only be used for the heavier grades of fuel oils.

It may be that the further development and price reduction of synthetic rubber and resins for tank linings will increase the use of concrete for exceptionally large oil reservoirs. One of the objections to this type of storage tank is the rather high percentage of reinforcing steel required compared to all-steel tanks. Nevertheless, every pound of steel that could be saved during the war has been a welcome contribution. *(To be continued).*

Importance of Temperature Controls in Machining Work

Temperature controls are usually advocated because of the fuel and labor economies effected by their use and are generally installed with a view to their cost being returnable out of the savings made by their automatic operation, but never have such controls been so necessary for uniformity and continuity of temperatures throughout an entire plant as they have today for the exacting requirements of war-time work. Parts must be machined to size with close tolerances of at least .001 in. and many parts are held to a tolerance of .0001 in. fraction. The parts are machined in various portions of the plant and if the local temperatures are equally at variance one with another, or particularly so with reference to the point of assembly, then at assembly a dimensional difference between parts will be found and as a consequence a number of parts must be rejected to scrap.

Certain machine operations are done at mid-day with the sun out and finished on night shifts when the outdoor temperature is usually much lower, but regardless of the outdoor temperature or other weather conditions or sudden fluctuations and interchange of such conditions, temperatures at each point indoors must be held constant at the point required. Parts for tools, gauges and fixtures are often made over a period of days in variable weather, but must fit when brought together for assembly, while limits and micro-finishes of ground surfaces are best held by grinders maintained at the proper temperature.

Refinements of today are the necessity of tomorrow as the nuisance value of things formerly tolerated become appreciated under stress of war-time requirements; for example, hydraulic machinery works better at properly held temperatures. Hydraulic control valves are sensitive and when the viscosity of the oil gets too heavy, the valves and the feeds fail to work properly. Instead of feeding up to the work rapidly and then dropping into the low cutting speed, the feeds often run the tools into the work at high speed, so that tools break, if not the machine, or the machine itself may travel through the limit valve and fail to reverse due to sticking valves, and the machine then jams.

Aside from these things, more uniform temperatures are required for comfort alone, for an industry which formerly employed say ten women, may now employ three hundred women, and women seem to be much more susceptible to drafts than are the men, and of course it is necessary to circulate much more air in many industries today in order to exhaust the dust created by the machining of a large number of castings at high speed. Numerous complaints are also received from machine operators as to cold wet hands from the handling of parts in and out of machines using cutting lubricants.—*T. W. Reynolds*

New Degree-Day Normal Figures for 210 Important Cities

The Weather Bureau recently compiled new degree-day normal figures for first-order stations. These appear on the pages which follow.

NEW degree-day normals, based on weather records from 1899 to 1941, have recently been calculated for all first-order weather stations (210 cities) by the U. S. Weather Bureau, and are presented on the accompanying pages. These are the standard monthly and seasonal normals now in use by the Weather Bureau, and were determined by detailed calculations for all days, separately, for the period covered. These new normals are presented through the courtesy of J. B. Kincer, Chief, Division of Climate and Crop Weather, U. S. Weather Bureau.

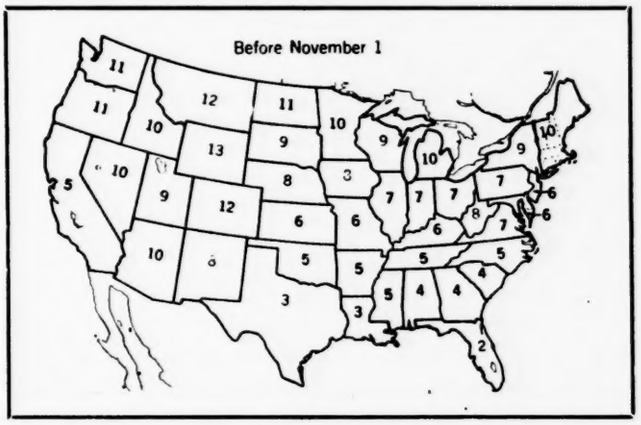
Many, and perhaps most, of the degree-day normals previously used were calculated by use of *monthly* averages. This was done by subtracting the monthly mean temperature from 65 and multiplying by the number of days in the month. This is accurate during winter months but an error is involved in warmer months, the error varying both geographically and seasonally. Consequently, the accompanying new normals are considerably more accurate, since they have been calculated from day-by-day data, as are current degree-days.

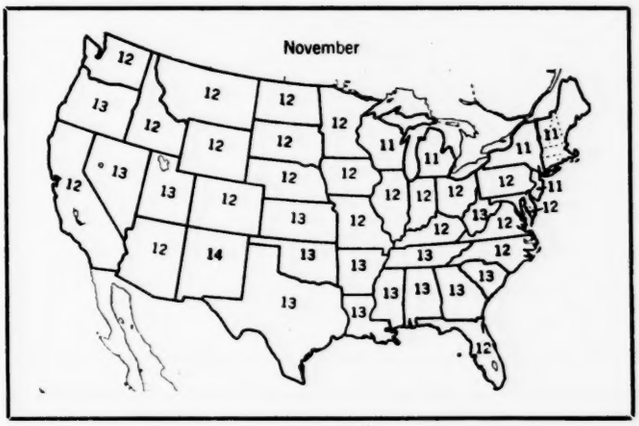
The accompanying figures, however, do not cover cities other than first-order stations, and consequently the error inherent in the previously used monthly average method is not involved. That error, particularly in spring and fall months, can be largely corrected by a formula developed by the Weather Bureau for use in approximating the monthly normals for stations where degree-days were never actually computed but for which normal monthly temperatures are available. The method used for such stations is: (1) When the mean monthly temperature is 40F or lower, use the method just described; (2) when above 40F use the equation

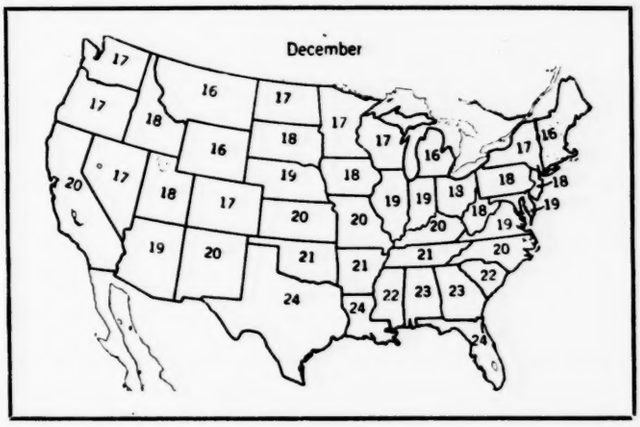
$$y = n \times a \times b$$

where n is the number of days in the month, a the mean monthly temperature, and b is a variable depending on a as in the accompanying table, and y is the number of normal degree-days for the month.

For computation of seasonal degree-days by this







Percentage of normal degree-days occurring in various months, during the heating season, by states. Similar figures for other months in the heating season appear on page 79.

a	b	a	b	a	b	a	b	a	b	a	b	a	b
74	.005	69	.02	64	.06	59	.11	54	.21	49	.31	44	.46
73	.005	68	.02	63	.07	58	.13	53	.23	48	.34	43	.49
72	.005	67	.03	62	.08	57	.15	52	.25	47	.37	42	.53
71	.01	66	.04	61	.09	56	.17	51	.27	46	.40	41	.57
70	.01	65	.05	60	.10	55	.19	50	.29	45	.43	40	.61

With normal daily temperature above 74F the number of degree days is negligible.

State and City	July	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	Season Total
ALABAMA													
Anniston	0	0	10	135	388	600	609	513	361	152	37	1	2806
Birmingham	0	0	7	104	341	568	586	502	318	133	23	1	2583
Mobile	0	0	1	45	203	374	392	317	178	54	3	†	1567
Montgomery	0	0	3	73	280	481	493	409	243	87	9	†	2078
ARIZONA													
Flagstaff	43	70	244	573	847	1111	1167	970	889	668	469	190	7241
Phoenix	0	0	0	19	168	388	404	261	152	47	7	†	1446
Yuma	0	0	0	9	113	306	319	181	85	22	3	0	1038
ARKANSAS													
Bentonville	1	1	4	216	516	810	879	716	519	247	88	7	4002
Fort Smith	0	†	12	130	409	708	761	623	393	159	34	1	3230
Little Rock	0	†	10	121	383	659	700	584	370	148	30	1	3006
CALIFORNIA													
Eureka	286	272	274	346	416	524	545	478	503	439	391	309	4782
Fresno	0	†	6	77	304	565	569	375	283	152	54	5	2390
Independence	†	†	28	216	512	778	799	619	477	267	112	18	3826
Los Angeles	1	†	5	43	110	225	276	232	209	158	104	27	1390
Redding	0	0	66	119	340	568	588	417	351	179	82	0	2710
Sacramento	2	1	17	100	332	588	596	403	324	201	103	21	2688
San Francisco	198	180	122	140	242	426	464	340	314	269	252	196	3143
San Diego	6	1	10	64	145	255	304	258	232	177	125	52	1629
COLORADO													
Denver	9	8	124	415	721	1012	1026	900	792	523	271	62	5863
Durango	25	37	201	535	861	1204	1271	1002	859	615	394	139	7143
Grand Junction	1	1	60	352	745	1149	1230	887	667	381	152	22	5647
Leadville	280	332	509	841	1139	1413	1470	1285	1245	990	740	434	10678
Pueblo	3	3	88	377	732	1042	1038	878	721	448	194	28	5552
CONNECTICUT													
Hartford	3	15	106	368	691	1052	1146	1062	871	525	216	46	6101
New Haven	3	12	89	341	660	1010	1103	1024	848	521	222	46	5879
FLORIDA													
Apalachicola	0	0	0	23	156	293	319	254	167	39	2	0	1252
Jacksonville	0	0	†	24	142	286	295	241	131	41	3	†	1163
Key West	0	0	0	0	2	15	22	15	7	†	0	0	61
Miami	0	0	0	†	15	40	54	44	31	3	†	0	187
Pensacola	0	0	1	35	181	342	365	300	171	51	3	†	1449
Tallahassee*	0	0	0	43	179	338	377	294	171	61	0	0	1463
Tampa	0	0	0	6	61	149	157	127	64	11	1	0	576
GEORGIA													
Atlanta	†	†	12	130	393	640	662	568	389	173	32	2	3001
Augusta	†	0	3	87	312	521	533	450	278	108	12	1	2305
Macon	0	0	5	91	324	527	539	453	283	109	14	1	2346
Savannah	0	0	1	46	209	386	395	335	200	68	6	1	1647
Thomasville	0	0	2	48	208	361	359	299	178	52	5	1	1513
IDAHO													
Boise	9	17	135	390	713	1025	1065	840	680	441	248	87	5650
Pocatello	13	22	173	481	814	1155	1219	1007	842	554	324	119	6723
ILLINOIS													
Cairo	0	†	25	184	494	817	878	758	522	239	60	3	3980
Carbondale*	0	0	22	201	511	862	933	776	503	256	62	0	4126
Chicago	7	8	84	334	709	1108	1219	1085	871	536	259	67	6287
Peoria	2	7	84	352	729	1115	1232	1039	801	438	173	25	5997
Springfield	†	3	63	290	666	1047	1145	988	732	382	130	15	5461
INDIANA													
Evansville (AP)	0	0	41	266	598	936	1035	843	621	314	119	11	4784
Fort Wayne	5	13	102	369	736	1088	1205	1050	879	503	212	40	6202
Indianapolis	2	4	65	299	663	1026	1104	982	751	414	155	22	5487
Royal Center	12	20	116	373	740	1104	1239	976	860	502	245	54	6241
Terre Haute	0	4	61	272	628	980	1073	903	705	363	132	14	5136
IOWA													
Burlington	0	0	61	187	741	1116	1274	1047	818	392	118	22	5776
Charles City	8	25	159	484	907	1361	1546	1289	1004	558	249	59	7649
Davenport	2	7	88	346	749	1170	1294	1119	846	452	166	28	6267
Des Moines	2	6	99	357	768	1200	1326	1143	849	449	165	27	6391
Dubuque	4	13	120	404	803	1246	1385	1199	927	498	199	39	6837
Keokuk	1	4	71	305	682	1083	1191	1025	761	397	136	18	5674
Sioux City	3	10	124	405	841	1267	1410	1216	913	487	194	37	6907
KANSAS													
Concordia	1	3	66	290	670	1056	1154	967	716	367	137	16	5443
Dodge City	1	3	58	276	644	994	1050	878	669	353	134	16	5076
Iola	†	1	40	236	579	930	1026	817	599	282	98	8	4616
Topeka	0	2	54	258	626	1008	1104	932	666	331	112	11	5106
Wichita	†	1	39	222	578	941	1021	847	606	294	97	8	4654
KENTUCKY													
Lexington	1	3	48	258	601	916	964	862	650	352	123	14	4792
Louisville	†	1	34	218	550	875	931	824	595	302	92	7	4429
LOUISIANA													
New Orleans	0	0	†	23	147	305	319	251	130	32	1	†	1208
Shreveport	0	0	4	71	274	499	522	421	243	83	10	†	2127
MAINE													
Eastport	159	148	274	528	831	1219	1353	1242	1090	778	532	300	8454
Greenville	68	114	315	640	1013	1455	1618	1441	1257	838	467	192	9418
Portland	29	46	179	459	792	1172	1296	1184	1003	668	375	135	7338
Presque Isle*	82	118	326	621	1041	1494	1708	1534	1271	813	440	196	9644
MARYLAND													
Baltimore	†	2	34	230	531	852	922	844	650	347	99	12	4523
Washington, D. C.	0	2	43	254	558	870	929	842	637	345	104	14	4598

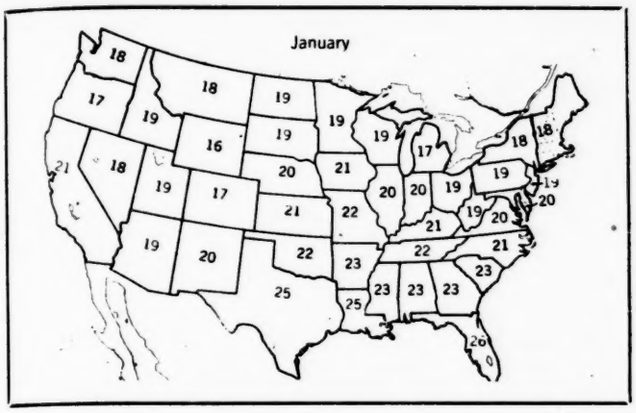
†Less than one degree day *Computed from Normal Monthly Temperatures.

State and City	July	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	Season Total
MASSACHUSETTS													
Boston	8	16	98	338	651	1000	1101	1027	852	538	248	66	5943
Fitchburg	12	29	144	432	774	1139	1240	1137	940	572	254	70	6743
Nantucket	16	16	88	316	594	898	1005	967	874	620	372	123	5889
MICHIGAN													
Alpena	54	81	233	548	877	1237	1390	1329	1176	770	447	171	8313
Detroit	7	15	109	387	753	1120	1228	1141	943	569	252	56	6580
Escanaba	56	87	255	574	930	1330	1505	1392	1233	813	477	171	8823
Grand Rapids	8	21	126	433	768	1129	1249	1150	962	575	263	57	6741
Houghton	71	96	263	581	964	1352	1539	1424	1259	820	472	193	9034
Lansing	18	37	164	466	825	1185	1305	1182	1018	604	292	79	7175
Ludington	41	55	182	472	794	1135	1271	1183	1056	698	418	158	7463
Marquette	87	102	257	556	927	1306	1471	1358	1208	801	493	220	8786
Sault Ste. Marie*	90	111	281	614	965	1373	1573	1478	1303	829	485	214	9316
Traverse City*	22	42	166	437	819	1169	1314	1252	1100	702	405	115	7543
MINNESOTA													
Duluth	82	100	289	636	1066	1541	1726	1504	1267	809	514	232	9766
International Falls*	62	119	299	722	1197	1711	1919	1607	1336	804	427	149	10346
Minneapolis	8	24	163	484	943	1415	1597	1379	1082	580	255	59	7989
Moorhead	20	47	240	607	1105	1609	1815	1555	1225	679	327	98	9327
Roseau	82	119	314	673	1218	1761	1987	1674	1386	741	389	132	10476
MISSISSIPPI													
Corinth	0	†	13	142	418	669	697	570	396	149	32	1	3087
Meridian	0	0	6	102	323	521	535	444	279	111	17	1	2339
Vicksburg	0	0	5	77	267	479	498	413	239	85	9	†	2072
MISSOURI													
Columbia	1	3	61	269	623	993	1080	929	664	342	118	13	5096
Kansas City	†	2	50	242	599	986	1083	921	657	327	106	11	4984
Saint Joseph	0	0	41	296	705	1097	1224	991	760	352	119	11	5596
Saint Louis	†	1	36	218	558	917	999	865	616	305	88	7	4610
Springfield (AP)*	0	0	41	251	580	914	1014	868	648	315	118	11	4760
MONTANA													
Billings	22	43	210	533	906	1209	1296	1081	936	522	310	116	7184
Havre	28	56	275	604	1010	1380	1548	1374	1108	623	338	128	8472
Helena	44	66	288	601	940	1245	1337	1155	982	643	409	184	7894
Kalispel	68	104	333	643	969	1240	1341	1143	950	633	412	215	8051
Miles City	7	21	182	516	914	1331	1472	1280	996	547	266	73	7605
Missoula*	42	81	312	621	966	1256	1330	1072	899	575	363	188	7705
NEBRASKA													
Lincoln	1	5	84	328	732	1142	1253	1070	798	411	161	23	6008
North Platte	4	10	129	415	802	1167	1238	1049	847	488	222	46	6417
Omaha	1	4	81	325	741	1163	1287	1098	813	414	152	21	6100
Valentine	8	20	164	484	877	1249	1357	1176	960	569	280	71	7215
NEVADA													
Reno	8	15	139	406	694	959	1007	788	693	494	197	108	5608
Tonopah	5	7	105	388	713	1010	1075	870	749	522	286	82	5812
Winnemucca	11	23	190	502	803	1099	1126	887	763	539	320	109	6372
NEW HAMPSHIRE													
Concord	18	47	189	494	824	1216	1334	1209	1001	634	309	100	7375
NEW JERSEY													
Atlantic City	11	2	40	250	552	864	943	893	762	489	215	37	5048
Cape May	1	2	38	221	529	852	936	876	737	459	188	32	4871
Newark	1	6	65	295	635	980	1083	1002	794	448	162	29	5500
Sandy Hook	1	2	40	268	579	921	1056	973	833	499	206	31	5409
Trenton	2	6	64	303	611	948	1027	927	769	446	162	24	5289
NEW MEXICO													
Albuquerque	0	0	28	264	658	916	959	712	591	331	96	5	4506
Roswell	†	†	24	195	521	786	775	591	437	203	52	2	3586
Santa Fe	10	15	129	451	772	1072	1094	892	786	544	297	60	6122
NEW YORK													
Albany	4	14	116	410	756	1139	1267	1174	955	549	221	44	6649
Binghamton	16	37	149	449	771	1130	1233	1160	966	585	271	74	6841
Buffalo	15	24	125	410	747	1102	1220	1168	1010	672	351	90	6934
Canton	28	61	218	551	902	1358	1508	1390	1162	698	346	109	8331
Ithaca	17	40	158	454	774	1130	1234	1155	981	606	294	84	6929
New York	1	4	51	274	600	934	1025	958	785	467	176	29	5304
Oswego	21	33	148	440	765	1145	1271	1193	1030	666	369	125	7206
Rochester	10	25	130	420	752	1111	1218	1154	978	604	283	70	6755
Syracuse	14	32	144	436	763	1136	1245	1168	986	611	286	76	6897
NORTH CAROLINA													
Asheville	2	3	49	282	566	795	818	722	568	321	115	15	4256
Charlotte	†	1	17	151	423	680	702	606	422	197	40	4	3243
Greensboro*	0	0	21	233	490	790	760	694	529	270	62	0	3849
Hatteras	0	0	1	62	275	493	565	531	398	194	36	2	2557
Manteo	†	†	7	113	358	595	642	594	469	249	75	7	3109
Raleigh	†	1	17	155	417	673	699	618	436	213	47	5	3281
Wilmington	0	†	5	92	310	514	528	481	328	147	25	1	2431
NORTH DAKOTA													
Bismarck	20	44	240	605	1059	1527	1720	1465	1187	650	335	104	8956
Devils Lake	42	78	299	701	1185	1681	1929	1621	1323	760	404	140	10163
Grand Forks	30	62	269	669	1160	1677	1910	1606	1304	719	348	117	9871
Pembina*	42	100	328	660	1248	1798	2089	1742	1445	795	380	132	10759
Williston	30	62	282	648	1101	1554	1753	1529	1234	680	363	124	9360

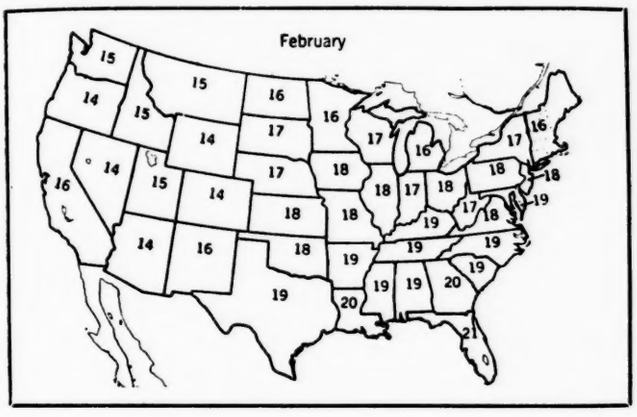
†Less than one degree day. *Computed from Normal Monthly Temperatures.

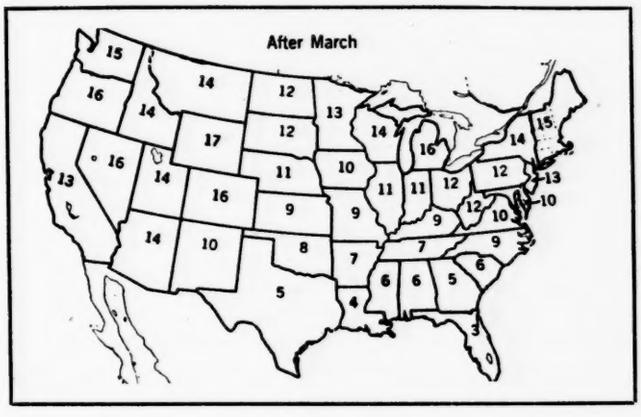
State and City	July	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	Season Total
OHIO													
Cincinnati	1	3	52	274	613	953	1009	905	681	374	132	16	5013
Cleveland	8	14	92	354	688	1040	1141	1074	892	558	255	56	6172
Columbus	2	6	68	318	674	1013	1081	982	762	436	167	26	5535
Dayton	2	6	70	310	663	984	1079	940	762	414	163	23	5416
Sandusky	3	8	81	349	698	1062	1154	1072	877	540	233	42	6119
Toledo	5	13	98	369	721	1090	1185	1090	889	534	226	46	6266
OKLAHOMA													
Oklahoma City	0	†	22	156	461	791	850	696	459	205	56	3	3699
OREGON													
Baker	56	72	261	541	848	1168	1219	987	821	604	412	210	7199
Medford	8	10	99	347	633	840	843	635	553	387	226	73	4654
Portland	29	29	109	298	540	729	775	622	530	370	241	107	4379
Roseburg	25	28	119	322	542	719	732	585	527	386	257	109	4351
PENNSYLVANIA													
Erie	8	17	101	368	698	1045	1156	1111	937	595	286	68	6391
Harrisburg	1	6	66	315	638	985	1070	979	770	427	150	22	5429
Pittsburgh	3	7	69	324	656	979	1043	971	767	448	170	29	5466
Philadelphia	†	2	36	236	548	877	957	885	697	379	117	16	4750
Reading	1	5	70	303	610	948	1033	931	756	426	150	22	5254
Scranton	6	21	117	400	720	1067	1157	1073	876	523	217	50	6227
RHODE ISLAND													
Block Island	10	11	80	315	600	914	1025	986	885	620	358	110	5914
Providence	6	17	104	363	675	1015	1103	1032	866	543	245	61	6030
SOUTH CAROLINA													
Charleston	0	0	1	48	227	421	450	386	245	84	7	1	1870
Columbia	†	†	6	98	330	554	568	488	312	129	18	1	2504
Greenville	†	1	12	127	410	635	684	549	413	183	42	1	3057
SOUTH DAKOTA													
Huron	9	21	174	507	966	1415	1586	1367	1044	579	264	67	7999
Pierre	4	12	134	442	885	1317	1466	1261	971	518	231	47	7288
Rapid City	15	30	188	498	839	1182	1311	1152	930	607	333	104	7189
TENNESSEE													
Chattanooga	0	0	12	149	432	684	708	606	417	188	39	1	3236
Knoxville	†	†	20	189	497	751	774	699	478	229	55	3	3695
Memphis	0	†	13	127	383	660	709	605	389	159	33	1	3079
Nashville	0	†	19	170	470	741	785	681	476	222	54	2	3620
TEXAS													
Abilene	0	†	10	97	337	602	616	492	297	114	23	2	2590
Amarillo	1	2	41	220	551	850	856	723	543	287	104	12	4190
Austin	0	0	0	29	235	399	447	324	185	51	3	0	1674
Brownsville	0	0	†	9	68	180	187	114	68	12	1	0	639
Corpus Christi	0	0	†	12	101	256	278	211	93	18	1	†	970
Dallas	0	0	5	70	298	571	596	445	284	95	14	†	2378
Del Rio	0	0	1	38	205	415	411	267	145	33	3	†	1518
El Paso	†	0	6	90	369	618	611	433	288	107	15	1	2538
Fort Worth	0	0	5	76	288	549	582	470	269	100	16	1	2356
Galveston	0	0	†	15	125	291	331	261	132	29	1	†	1185
Houston	0	0	†	27	162	331	356	253	154	38	2	0	1323
Palestine	0	0	4	69	265	494	508	410	238	84	11	1	2084
Port Arthur	0	0	1	27	181	325	371	249	155	39	2	0	1350
San Antonio	0	0	†	32	169	361	381	290	148	38	4	†	1423
UTAH													
Modena	7	11	156	503	833	1151	1191	944	811	569	336	93	6605
Salt Lake City	4	5	95	377	712	1040	1084	868	709	450	233	62	5639
VERMONT													
Burlington	25	52	211	528	875	1304	1460	1340	1130	696	345	107	8073
Northfield	63	112	284	604	950	1389	1522	1385	1180	753	409	168	8819
VIRGINIA													
Cape Henry	0	†	7	126	401	670	726	686	534	306	90	7	3553
Lynchburg	1	2	37	232	524	793	829	735	545	290	82	12	4082
Norfolk	0	†	9	132	397	664	709	654	493	257	65	5	3385
Richmond	†	1	27	199	491	775	812	727	548	281	74	9	3944
Roanoke	0	0	41	249	522	806	843	722	508	287	86	11	4075
Wytheville	7	13	82	352	662	916	945	836	677	410	168	35	5103
WASHINGTON													
North Head	256	231	258	355	491	644	700	599	608	505	433	313	5393
Seattle	71	71	174	372	558	708	765	644	595	440	304	162	4864
Spokane	21	37	185	483	816	1061	1137	935	748	488	282	113	6306
Tacoma	75	77	193	395	583	738	788	657	610	457	317	169	5059
Tatoosh Island	303	295	326	426	535	656	721	632	642	538	458	351	5883
Walla Walla	6	11	92	319	660	912	977	778	566	355	187	54	4917
Yakima	8	18	129	404	779	1055	1127	849	616	375	195	57	5612
WEST VIRGINIA													
Elkins	15	23	113	403	724	997	1030	950	774	492	233	59	5813
Parkersburg	1	3	55	287	619	922	975	888	671	371	129	17	4938
WISCONSIN													
Green Bay	17	39	176	496	892	1327	1498	1337	1099	663	325	89	7958
La Crosse	7	22	154	454	865	1339	1500	1290	1001	533	227	50	7442
Madison	8	21	142	456	859	1291	1457	1252	1017	594	272	64	7433
Milwaukee	13	18	120	409	788	1198	1329	1181	969	621	340	100	7086
WYOMING													
Cheyenne	42	48	247	592	880	1147	1188	1070	994	726	455	160	7549
Lander	29	44	263	630	1020	1401	1423	1198	1000	674	407	150	8239
Sheridan	3	17	340	632	814	1232	1227	971	951	651	275	126	7239
Yellowstone Park	125	173	424	759	1079	1366	1464	1252	1165	841	603	334	9605

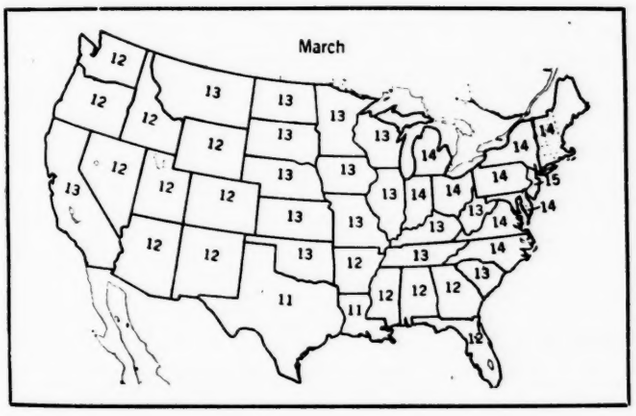
†Less than one degree day. *Computed from Normal Monthly Temperatures.

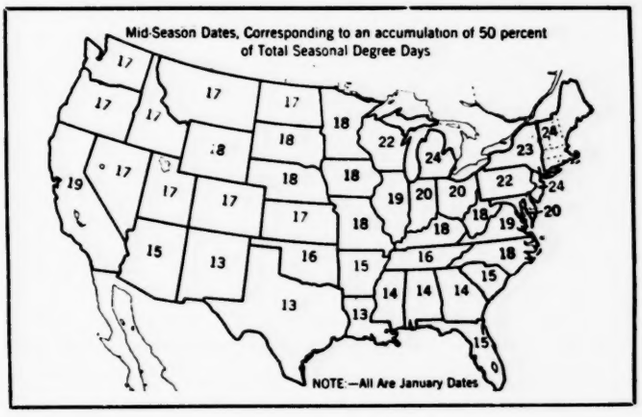


Percentage of normal degree-days occurring during various months of the heating season by states. Data for earlier months in the season appear on page 75. The second map below shows the date in January when the heating season is half over during a normal year.





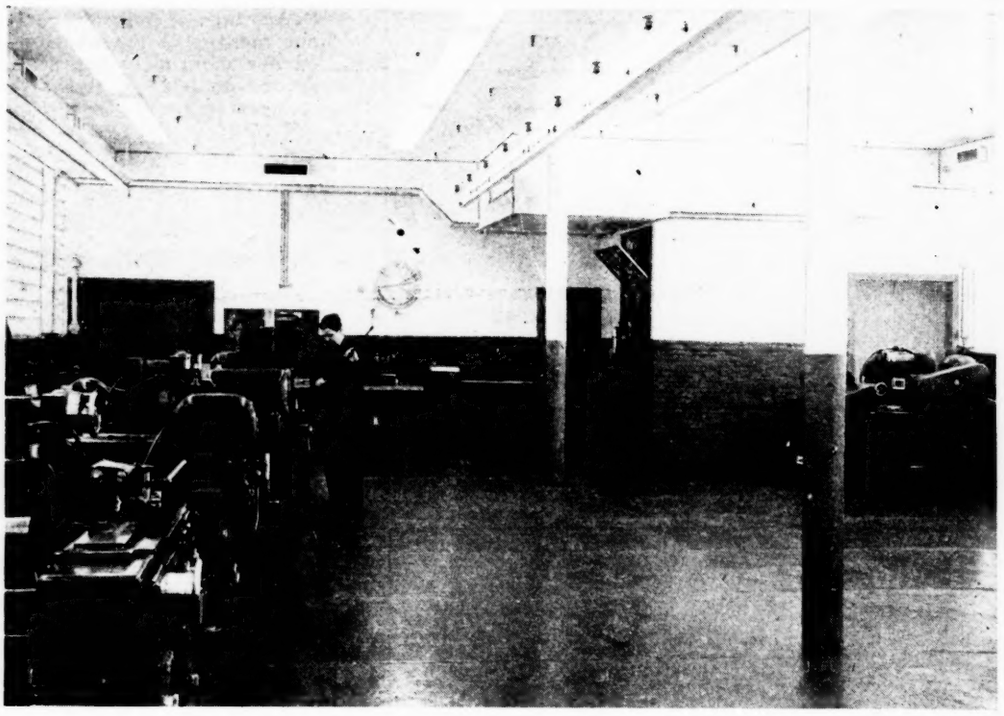



Mid-Season Dates, Corresponding to an accumulation of 50 percent of Total Seasonal Degree Days
NOTE.—All Are January Dates

method, the following comparisons afford an indication of the approximation obtainable, the figures given being the percentage error of the computed values compared with those obtained by using monthly averages without adjustment: Northfield, Vt., 0.8%; New York City, 2.3%; Columbus, Ohio, 0.9%; Washington, D. C., 2.7%; Atlanta, Ga., 2.3%; New Orleans, La., 3.5%; Fort Worth, Tex., 3.7%; St. Louis, Mo., 0.5%; Chicago, Ill., 1.5%; Bismarck, N. Dak., 3.4%; Denver, Colo., 3.3%; Salt Lake City, 0.0%; Minneapolis, Minn., 0.9%; Spokane, Wash., 2.1%; and Portland, Ore., 3.7%. The average error for the 15 stations is 2%. It may be noted that the formula applies as well to New Orleans, with only some 1200 degree-days, as to Bismarck, N. Dak., with nearly 9000.

The accompanying maps were prepared by using the foregoing method as applied to *state* monthly averages, and are reproduced by permission from the Weekly Weather Crop Bulletin of the U. S. Weather Bureau.

It should be reiterated that the tabulations presented here are those based on actual degree-days, and not by use of the formula just described.



Air conditioned research and test room of the Landis Tool Co., Waynesboro, Pa.

Accuracy Aided in Research and Test

TERRY MITCHELL
Mechanical Engineer, Frick Company, Waynesboro, Pa.

As a means of achieving a higher degree of accuracy, the Landis Tool Company air conditioned a new research and test room.

MAKERS of fine tools, gages and dies, and of a wide range of equipment from delicate instruments to huge gears, are finding air conditioning indispensable in securing uniform accuracy.

One manufacturer, the Landis Tool Company, Waynesboro, Pa., specializes in the building of precision grinding machines. Landis engineers developed cam and crankshaft grinding, steel mill roll grinders with built-in cambering mechanism, hydraulically operated grinders, use of large-diameter grinding wheels, wheel spindle end drive through V-belts, and a special high production cam grinder for radial-type airplane engine cams.

The air conditioned research and test room at the Landis Tool Company is 75 ft long and nearly 39 ft wide, with a height of 13 ft.

The research room has wall of glass brick above the 5 ft level. Extending along each wall are conduits with numerous electric outlets in the voltages used for both power and lighting work in the machine-tool industry. A power crane extends the length of the room on one side. Ample fluorescent lighting is provided by fixtures placed flush with the ceiling. Heavy work benches and fire protection apparatus complete the normal equipment of the room, but many pieces of special equipment are brought in from time to time as a complete line of electrical instruments for checking and testing, and several Sheffield gages, one of which measures to less than four millionths of an inch by electrical means.

Air conditioning equipment was installed in a room in one corner of the ground floor space. The system, at present, gives compensated control to match changes in weather conditions, but can be supplemented with devices to maintain "straight-line" conditions the year around. The temperature inside is now increased one degree for every three degrees of rise outside.

The inside temperature can be set at say 70F, and if the temperature outside goes below this point, steam is admitted to the heating coil and the room is kept at a minimum of 70F, dry bulb. The relative humidity is maintained between 45 and 60 degrees, and averages about 50. The space is very comfortable at all times, as this variation is well within the comfort zone.

A feature of this installation is a Westinghouse Precipitron air cleaner, so placed that both fresh and recirculated air are carried through it. The doors giving access to the Precipitron equipment are fitted with long eyebolts, which must be unscrewed before the doors can be opened. Removing

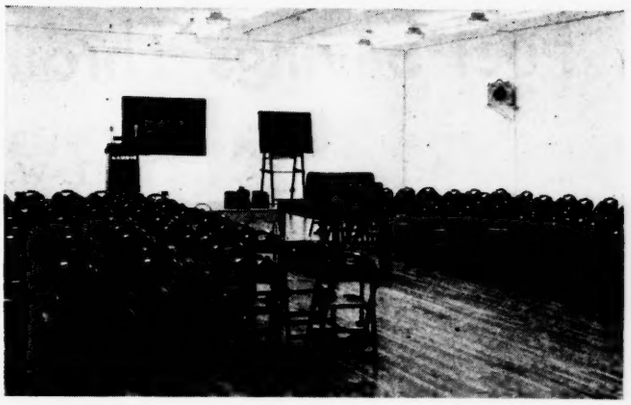
these bolts cuts off the high-tension current which charges the plates of the cleaner.

The conditioner operates on the automatic by-pass system: 75% of the air is normally recirculated, and 25% is fresh air. The fresh air passes through an automatic damper and is warmed when necessary by a steam preheating coil. Air then mixes with a portion of the return air, passes through the precipitron filter, and then through the cooling or reheating coils, before entering the fan. The galvanized cooling coil has finned pipes, and is 16 pipes wide by 8 rows deep. The finned steam coils are 16 pipes wide, but the preheat coil is only one row deep and the re-heat coil two rows. All these coils, as well as the casing for the entire air conditioning unit, were built in the Frick shops.

The unit is insulated beyond the cooling coil. Carey moulded asbestos ducts are used with ½ in. insulation for the first floor and 1 in. insulation above the ceiling of the second. Air outlets are equipped with T. & B. Santrols.

The fan is of the Sirocco type, driven by a 5 hp motor through V-belts. It is located on an overhead platform, and delivers 8,000 cfm. Extra pulleys permit a change in fan speed. Automatic dampers in the duct system direct the air to either side of the test room as necessary to meet varying wind and sun loads. The air returns through a large grille, 7 ft high. Automatically operated dampers direct the conditioned air to the meeting room upstairs, when use of this room creates a demand. The same temperatures are maintained on both of these floors.

Directly above the research room is a foremen's meeting hall of about the same size. In addition to air conditioning, the meeting room is equipped with modernistic lighting, sound amplifiers, a motion picture projection booth, hardwood floors, and other conveniences. One end of the meeting hall is divided off to make a 20 ft long committee room adjoining the projection room. The motion picture equipment is arranged so that it can be turned and the picture thrown on a screen in the small room.



The foremen's meeting room is also air conditioned

Refrigeration is supplied by a Frick 5 by 5 combined ammonia unit, driven by a 20 hp Westinghouse motor. Capacity is 20 tons. Float valve control of the expansion type is combined with the use of a back-pressure valve and a small accumulator. Compressor motor speed is controlled primarily by the amount of air to be cooled and dehumidified. Pressurestats are added and used for correction of abnormal conditions. A speed-changing pressurestat, operated by the suction, controls the 2-speed compressor motor so as to run the machine at high speed if the suction pressure is above 40 lb and at low speed (200 rpm) below 40 lb. A low-pressure cut-out stops the machine at 5 lb and permits it to start again, at low speed, at 25 lb suction.

The automatic dampers on the air conditioning equipment are operated by a Minneapolis-Honeywell pneumatic system which is tied in with M-H pneumatic-electric relays to the motor starters. Compressed air for this pneumatic system can be obtained automatically, either from lines connected with the power house or from a small air compressor supplied for the purpose.

Industrial Hygiene in Hot Weather

High temperatures of summer months bring a number of hygienic problems in industry. Comfort and health of workers, as well as efficiency in production, depend to a considerable extent on the degree to which hot weather conditions are controlled.

In operations involving the use of organic solvents, care must be taken to prevent changes in the ventilation rate from causing the solvent vapors to escape into the workroom atmosphere in concentrations above those known to be safe, according to Safety Research Institute.

Since many organic solvents are of high volatility, those which may be used safely in cool atmospheres may form excessive concentrations of vapor in hot atmospheres, unless exhausted. Efficient local exhaust ventilation will solve this problem. In operations where the solvent is used intermittently or in small amounts, open windows may provide sufficient ventilation for safety, depending upon the nature of the solvent. However, where local exhaust ventilation is provided for safe use of solvents in tanks, employees generally should not be allowed to open windows; the currents of air thus created may disperse unsafe amounts of vapor into the workroom atmosphere, or, if the solvents used are flammable, may increase the hazards of fire and explosion. In such instances, to maintain a comfortable as well as safe workroom atmosphere, general exhaust should be provided, in addition to local exhaust.

Unqualified employees should not be allowed to tamper with ventilating devices provided for safety, or shut them off, as occasionally happens because some individuals prefer the natural ventilation of open windows.

Fuel Savings Through Energy Reductions

T. W. REYNOLDS

AIR conditioning, as contemplated for a certain group of buildings, was ruled out momentarily as too costly due to necessary wiring changes. Further studies were then made, this time with a view to the reduction of energy load, so that the existing electrical system might be used without overloading the wiring. It was found that this could be done by changing the lighting system from incandescent to fluorescent.

The case cited is a striking example of the reduction of energy, and therefore of fuel, as effected by fluorescent lighting. Just what the possibilities are is further shown in Table 1 where an incandescent lighting system of the given size is taken at 100%. By subtraction, the fluorescent system shows a fuel saving of 64% and this is aside from any energy saved in the ventilation or air conditioning load due to any difference in heat transmittal of the lamps.

Proving out the table with respect to the 64% saving, let us assume an area for illumination at an intensity requiring 100 100-watt lamps, or a total of 10 kw. This would result in 160,000 lumens, as the light output of a 100-watt light is 1,600 lumens.

By comparison, using 40-watt white fluorescent lamps, each with a light output of 2,100 lumens, only 76 lamps would be required (160,000 ÷ 2,100 = 76), or 3,040 watts plus 76 single lamp ballasts at 9½ watts each, giving a sub-total of 722 watts and a grand total of 3,762 watts. This would be about 38% of the wattage required by incandescent lighting for the same lighting intensity.

This is ideal pre-war design, so assuming two lamp ballasts, the only ones obtainable today, we would only require 3,529 watts, or about 35% of the wattage needed by the given incandescent lighting system, figured as:

(76 ÷ 2) = 38 ballasts × 15½ watts plus 3,040 watts = 3,529 watts.

We might even proceed still further and use three lamp ballasts where three-phase current is available, especially so as this would require slightly less copper, would be cheaper and would eliminate any flicker of lights where there is such a tendency.

So it is apparent that the energy savings due to the use of fluorescent lighting can be actual, not theoretical, providing the intensity is held the same in comparative calculations. Of course this is not true where the owner, deciding that the energy cost is unimportant, steps up the fluorescent intensity with a feeling that he is getting more light for the same money he would have to spend for incandescent lighting, and especially so where he was dissatisfied with the intensity formerly given by incandescent lighting. The trend is towards better lighting.

Some engineers claim that the absence of shadows requires higher intensities when fluorescent lighting is used. It is held that we see by contrast. For example, place one paper partly over another and the edge of one becomes apparent by contrasting shadows or colors. It is further held that there are no shadows with fluorescent lighting at low intensities, having in mind the effect of direct sunlight outdoors where the intensity is so great you cannot eliminate shadows.

It would seem that the mere statement "absence of shadows" indicates an even level of illumination as desirable for general lighting with either incandescent or fluorescent lamps. As a matter of fact, the surface brightness or intensity of a fluorescent lamp is considerably less than that of an incandescent lamp. This is due to its larger area and line type of distributing light as compared to the pin point source of light of an incandescent lamp. The contrast due to shadows when using fluorescent lighting is therefore reduced, but is not eliminated.

TABLE 1.—ELECTRIC LIGHT—FACTORY SERVICE RELATIVE COSTS WITH RELATIVE ENERGY OR FUEL SAVINGS

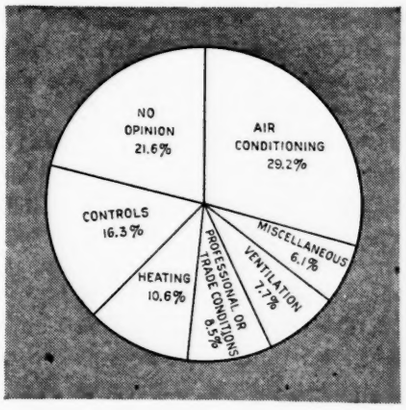
Character	Energy Required per Year		Cost			
			Installation		Operation	
	Kva	%	Dollars	%	Dollars	%
Incandescent	281	100	8,926	100	15,023	100
Mercury	153	54	12,561	141	10,498	90
Combination Mercury and Incandescent..	174	62	6,799	76	10,488	70
Fluorescent	101	36	18,240	204	9,220	61
Cold Cathode	184	65	25,530	286	13,870	92

Planned Power Transmission

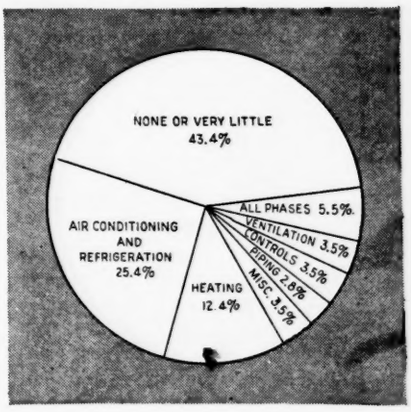
Planning power transmission with a modern group drive has been another means of saving energy or fuel. Studies have indicated that the reduction of horsepower by group drive is fully 25%. While the installation cost is reduced 40%, the drive efficiency increased 7% and the power factor improved 15%. The load factor and connected horsepower are reduced due to the diversity of power loads in machines when properly grouped. Power is saved where only a comparatively few larger motors of correspondingly high efficiency are required. Larger and more fully loaded motors have inherently better power factor characteristics and larger motors and their required wiring and controls cost less per installed horsepower than do small ones.

Post-War Designs Relatively Unaffected by War, Survey Shows

AIR conditioning and controls both need further development after the war, according to consulting and architectural engineers surveyed by HEATING AND VENTILATING in regard to their views on post-war possibilities. Twelve questions were asked in the survey, which covered over 1,300 offices, two-thirds of which are now engaged in the design and specification of post-war projects. Analysis of the replies to two questions appeared in the July issue, while four others were covered in the August number.



Features that need further development after the war.



Phase of practice most affected by war.

Air conditioning and controls lead in the phases of the art which need further development after the war, according to responses to the question: *What phase of heating, ventilating, refrigeration, piping and air conditioning most needs further development?*

To this question 29.2% of the answers were classifiable under some form of air conditioning or related subjects; 21.6% had no opinion; 16.3% referred to controls in one way or another; 10.6% mentioned heating or related functions; 8.5% mentioned professional or trade conditions; 7.7% answered ventilation; and 6.1% of the replies were on miscellaneous subjects.

Almost half of those who mentioned air conditioning did not qualify their answer or specify exactly what was in their mind. Scattered answers were received on the following: Air cleaning, (4.9%); refrigeration, (3.7%); with the following all referred to by less than 2% of those responding: Same equipment for heating and cooling; office air conditioning; refrigeration with economical use of water; residential air conditioning without cooling; operation of air cooling and dehumidification; radiant cooling; heat pump; low cost air conditioning; dehumidification; humidification, and more substantial refrigeration equipment.

Half of those who referred to controls did not identify in detail what phase needed development but an appreciable number (3.2%) referred to temperature control while almost as many (2.9%) referred to humidity control. Scattered votes were received for zoning, sub-zero controls, instruments, and refrigeration controls.

In the heating and fuel burning category only one subject drew an important percentage of the total number of votes for the category and that was radiant heating; scattered votes were cast for stokers, boilers, radiators and convectors, fuel burning devices, central heating serving a number of buildings, vacuum heating, unit heaters, and residence heating.

Of the 8.5% of those who referred to professional or trade conditions, almost a quarter mentioned cost, while scattered percentages reflected opinions on labor simplification, modernization, standardization, better coordination among architects and contractors, codes of minimum requirements, terminology, flexibility, and education.

Among those who mentioned ventilation, the majority did not specify what phase of ventilation needed improvement but others mentioned such subjects as duct design, air distribution (including high velocity air distribution), unit ventilators, and fans.

Among the miscellaneous were a fairly high number of votes for packaged units of one kind or another, and votes for vibration and sound control and elimination, equipment in general, plastic piping, together with the rather unusual recommendation that further attention be paid to the location of buildings, prevailing winds, and orientation in general.

In reply to the question *What phase of heating, ventilating, refrigeration and air conditioning has been most affected by the war in your own case? In other words, which of your own practices has been most changed by the war so far as post-war designs are concerned?* the majority of those replying gave

(Concluded on page 106)

Hot Air Trouble in School

By JOHN J. WOOLFENDEN

Engineering Staff, Smith, Hinchman & Grylls, Inc., Architects and Engineers, Detroit, Mich.

SOMETHING like thirty-five or forty years ago, the "Cosmopolitan" magazine (if recollection is correct) published, from time to time, various proverbs, revised. Among these was one the memory of which, perhaps on account of its undisputable truth, still remains as vivid as ever: "Big aches from little toe corns grow." The same idea has been expressed in other words by the saying that big things rarely, if ever, cause trouble; it is usually the small things, which are easily overlooked, that later disturb our sleep; or as Michael Angelo put it, "Trifles make perfection and perfection is no trifle."

Conversely to the last, lack of trifles may result in imperfection and imperfection may mean trouble. Too often, the smaller the imperfection (i.e., the less evident it is), the greater the trouble.

About fourteen years ago, a school building was built as the first unit of the proposed ultimate structure. In the design, provisions were made for the future addition. In fact, in order to make the future work of extension as simple as possible, the first unit was built as though the whole building were built and then the future portion cut off and removed.

The heating system was of the hot blast type, with supplementary radiation, either exposed or concealed as required, in the Conservatory, Library, Kindergarten, Vestibules and also in the rooms at the corners of the building on account of their greater exposed wall surfaces. The air ducts supplying the Vestibules at the northerly and at the south ends of the building were taken off the tempered air chamber and connected to boots underneath the heating surface. This heating surface, in each case, consisted of a small bank of cast iron blast heaters enclosed in a suitable casing and set in a recess. Each coil was provided with a thermostatically controlled valve in the steam supply connection.

Fan Placed in Basement

The fan, located in the machinery room, in the basement, discharged into a masonry plenum of the "double duct" type, with a masonry partition dividing the hot air and the tempered air chambers. This plenum ran from end to end of the building, under the corridor and each portion of it was about 5 ft. 6 in. wide and slightly over 9 ft. high.

The usual tempering and retempering (or heater) coils were installed and the branch ducts were provided with mixing dampers, as indicated in the section shown in Fig. 1 and the plan in Fig. 2.

The system was put into operation in September, when school opened and ran for some time with apparently no particular difficulties until the cold weather set in, when it was reported that the corner rooms were found to be somewhat sluggish in coming up to temperature, especially on Mondays.

Existing Conditions

A series of observations was made and a number of temperature readings taken. Briefly, the conditions and symptoms found were substantially as follows:—

1. Hot air entered the plenum at 120F.
2. Air temperature at the extreme (south) end of the hot air chamber varied; on Fridays it was found to be normally about 110F, while on Mondays it might be as low as 90F, when the apparatus had been running for an hour or two.
3. Temperature in the hot air chamber was not constant, under continuous operation, but fluctuated 20F or more, at times, the initial air temperature being constant at 120F.
4. Air temperature in the tempered air chamber, at the extreme end, soon after the apparatus was started, stabilized at between 70F and 71F, with air entering the chamber at 78F.
5. When the rooms were finally brought up to temperature, and the control was thrown over onto the automatic controls, the rooms which had been warmest were soon cooled off.
6. When the intermediate, or center, rooms had been brought up to temperature, those which lagged behind might be as much as 10F lower in temperature.
7. Readings at the northerly end of both chambers showed much less drop in temperature. Such conditions as those given above were found when the outside temperature was +6F.

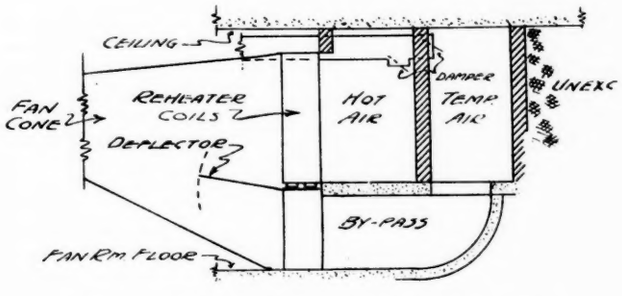


Fig. 1. Cross-section through plenum at fan.

Various suggestions were made; two of the most meritorious being (a) to overcome the drop in temperature of the hot air chamber by installing a booster coil toward its southerly end and (b) to overcome both the drop in temperature and, more

especially, the fluctuations in temperature, in the hot air chamber by taking the duct connection to the south vestibule off the hot air chamber instead of off the tempered air chamber.

Of these suggestions, the latter one seemed to be the more logical. In view of the general aspect of the situation, the installation of a booster coil appeared unnecessary, or at least unjustifiable unless other remedies that were tried failed to produce the desired results.

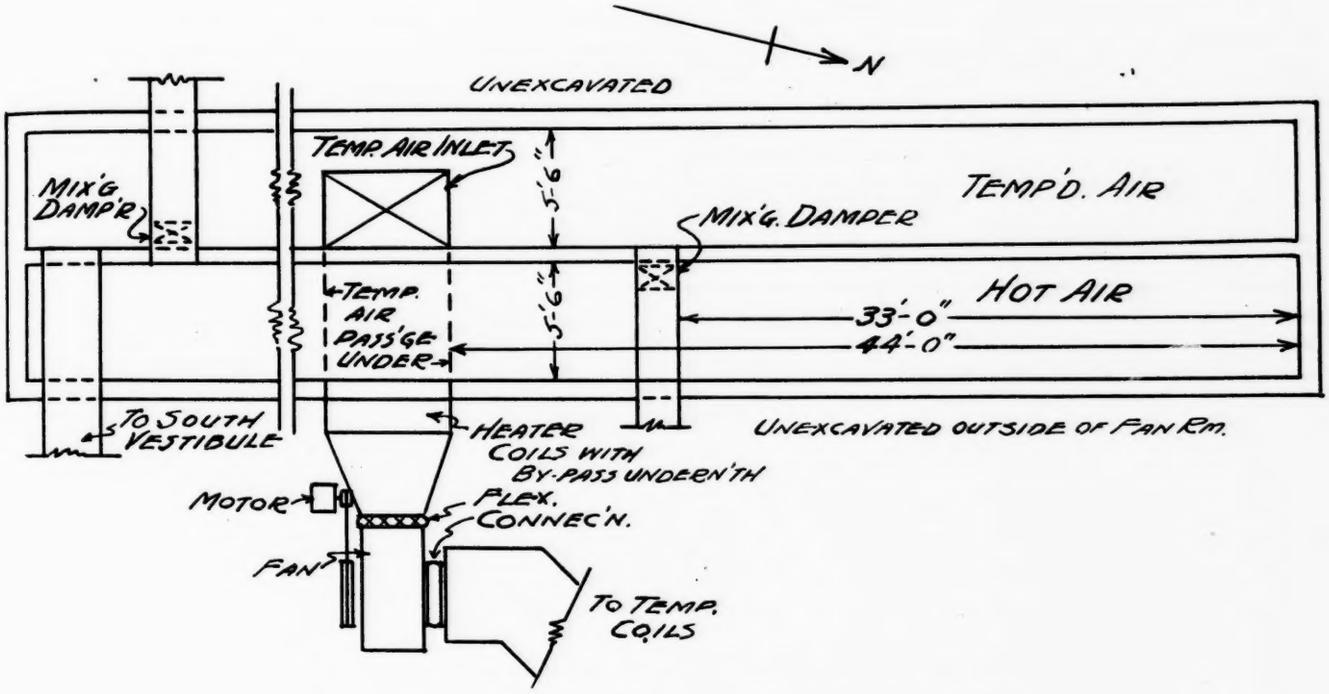


Fig. 2. Showing arrangement of fan coils, ducts, plenums, etc.

Conclusions Established

A review of the data led to the following conclusions:—

1. That the heat loss in the plenums was due to the transmission through the walls and floors, which were in contact with the cold earth, the greater part being probably lost through the walls;

2. That the drop in temperature in the tempered air chamber was of secondary importance and, while appreciable, need not be considered. This was the more true since the temperature drop was not sufficient to cause trouble and because the heat lost was transmitted to the earth under the building, at about 25 feet from the outside walls (except at the ends) and, therefore a considerable portion of it would tend to warm the ground floor, which, except over the plenums and the machine room, was on the earth, with no excavation under;

3. That the fluctuations in temperature in the hot air plenum were due to the fact that, when the rooms became sufficiently warm, the hot air demand was correspondingly decreased, or even reduced to zero, and the air in the plenum, practically stagnant under such conditions, rapidly cooled off—when the controls thereafter called for hot air, this relatively cold air was delivered to the rooms; and

4. That the difference between temperatures on Fridays and Mondays indicated that the system had sufficient capacity to carry the load imposed upon it but, under the more extreme conditions, was unable to pick up the load with the desired rapidity.

It seemed that the first measures to be taken were to change the duct to the south vestibule and to reduce the heat loss from the hot air chamber. To accomplish the latter result, a partition of insulating tile was built across the hot air plenum, just north of the fan connection, thus shutting off the useless dead end.

Volume Dampers Removed

There were also a few minor items, of a more or less routine nature, taken care of at the same time. The temperature regulation system was checked up and any necessary changes in adjustment were made and the volume dampers (manually operated) at the tops of the two vent flues from one of the more sluggish rooms were removed. These dampers had been found, on several occasions, in a nearly closed position and their removal would effectually cure any tendency for unauthorized tampering. The volume dampers in the supply ducts would suffice for the necessary volume control.

A series of readings taken after these changes were made, showed that the improvement in results had been of major magnitude. The fact that no further complaints were received justified the belief that a cure had been effected.

WASHINGTON NEWS

Limited Reconversion Being Impaired; Stoker Problems Are Considered; Freon Control is Extended

Summarized by LORING F. OVERMAN

This column's frequent observation to the effect that "the unwinding of wartime restrictions would occasion more headaches than the winding" seems to have been borne out by recent Nelson-Wilson-Krug-Army and Navy controversies over reconversion policies.

From the conversations, resignations, trips to China, and surprise appointment of a Navy Lieutenant Commander to gather up the loose ends it would appear the subject is so hot that those who had been expected to make the decisions cannot even discuss the subject without unprecedented flareups of tempers and tongues.

Appearances Deceiving

It should not be concluded, however, that the whole reconversion picture is one of chaos. There are whitecaps on the surface, but deep down that same strong current that has enabled this country to engulf its enemies in an unbelievable flood of war production is still flowing. Within the subterranean caverns of the War Production Board, scarcely more than aware of the battle of the Big Shots, the industry division staffs that have engineered a munitions miracle are getting their individual houses in order for the turnabout that will accompany cessation of hostilities.

These industry divisions are not asleep at the switch. They are not coasting along on well-earned war production laurels, awaiting with folded hands the settlement of the top-flight battle and the word to "go ahead." Composed chiefly of men from industry, assisted by industry advisory committees composed of men now active in industry, these WPB Divisions have in readiness conversion plans that are far ahead of the official announcements of topside policy.

Why An Announcement?

Analysis of the Nelson-Krug-Wilson-etc. affair prompts the conclusion that it may not have been the reconversion policy that is at fault, but the seeming necessity for making a public announcement of a policy. Army and Navy agreed with industry that the policy should include preparation for conversion at the earliest possible moment. Industry advisory committees were thoroughly informed regarding plans for their own particular groups, and were generally satisfied that when the fish start biting, the necessary licenses and tackle will be available.

Perhaps if each industry division —ours included—had been permitted to proceed as it has been, and is, the changeover could be accomplished, when the time comes, with none of the bitterness and unfavorable publicity that has developed. As things stand now, an overall program for specified reconversion has been announced, but its effect on producers of major items is expected to be nil. True, certain producers of trinkets and gadgets may appear to be ahead of the game as a result of the order, but even that is doubtful. There are "trinket and gadget" divisions within WPB too, and they are no less insistent on seeing that their industries are properly treated than are the divisions representing the heating - ventilating - air conditioning industries.

PR-25 Nebulous

So the publication on August 15 of the much heralded Priorities Regulation 25, permitting spot authorization of limited reconversion by WPB Field Offices, has been so hedged with if's and whereases that its overall effect is not expected to be of much importance, one way or the other. As far as it concerns industries represented by HEATING AND VENTILATING, it seems like the long way 'round to request WPB field offices to grant AA-5 ratings and to authorize construction, when the applicable Industry Divisions are clearing the decks to pass out higher ratings as soon as the necessary components become available, and as soon as producers report unoccupied spots in production schedules.

Perhaps it should not be inferred that PR-25 is entirely a needless user of scarce paper. It is, after all, sort of an enabling act in which certain plumbing, heating and air conditioning items are singled out for favorable treatment when conditions permit. For the present, those favorable conditions do not exist. When they do, PR-25 might have the effect of putting products of our industries out in front when limitation and conservation orders are reviewed by the respective industry divisions, each one interested in seeing that its constituents get a fair break.

Industry division officials have indicated that within a few hours after news of peace, estimates of applicable cutbacks would be available, and only a few more hours would be needed for the individual divisions to adjust the 270 "L" orders that limit the types of civilian products that may be made, and the 267 "M" orders that conserve materials by restricting the amounts that could be used in fabricating specified products.

A-C Advisory Meets

Members of the General Refrigeration and Air Conditioning Advisory Committee, meeting in Washington, August 16, reported no lack of postwar planning evident within this WPB Division. Quite the reverse, for they reviewed the recommendations of 11 task committees representing branches of the industry and looked over a preliminary compilation of the most comprehensive set of figures ever made available to the industry as a whole. This compilation, being completed by the Bureau of the Census following submission of reports of 1940 production by all segments of the industry, will, when completed, make available for the first time the overall pictures of refrigeration and air-conditioning production by type of product, component, metal utilization and man-hour consumption.

This census compilation, to establish an industry-reported base period, is to be used in determining fourth-quarter action of recommendations submitted by task committees, and as a basis for easing the industry into the conversion period as rapidly as manpower and materials become available. Reports of the task committees included estimates of postwar needs, and recommendation that a specified number of units be authorized immediately, largely for replacement purposes.

Recommendations regarding fourth quarter production are being considered by WPB with the realization that fractional horsepower motors copper and sheet steel comprise

bottleneck promising to continue until military demand definitely slackens.

Order L-38 Amended

An amended and simplified version of Order L-38, the order controlling production of refrigeration equipment, made its appearance August 28. As forecast in last month's *Washington News* column, the major change was one of form—with a long list of restricted products replaced by a Schedule A fixing production quotas for all products of the industry. No items restricted in the previous list have been freed by the new Schedule; the restricted items are merely assigned a zero quota for the present. Come victory, these zero quotas can be quickly given meaning by assigning a specified quota.

Another change requires that all applications under the order be filed with WPB field offices on form 1319 or form 617—eliminating forms 2448 and 2449, formerly sent to division headquarters in Washington. There are two exceptions—jobbers are to file applications on Form 547 and for export, applications are to be filed on FEA 419 or WPB 541.

Freon Control Extended

The expected release of freon for comfort air condition has been delayed. Scheduled to expire on August 31, the list of restricted deliveries was extended to September 30 by amendment of Order M-28. Explanation is that the first carload of freon from the first of two new plants at East Chicago, Ind., was not shipped until the third week in August, while the second plant is not now expected to get into production until October.

Instead of releasing all freon on August 30, as was hoped might be done, WPB found it possible only to issue a directive releasing small amounts to theaters able to prove real hardship. By August 26, a total of 140 appeals from theaters had been received, and 50 approvals had been signed on August 30.

Present indications are that November 1 will see an end to all restrictions on deliveries of freon to comfort air conditioning systems and to refrigeration classifications now on the restricted list.

Stoker IAC Problems

Another case of where government plans for civilian production may exceed industry's capacity to deliver was cited at the July 27 meeting of the Stoker Industry Advisory Committee Meeting. Here representatives of the Plumbing and Heating Division and the Office of Civilian Requirements presented estimates of present needs for both Class A and Class B stokers—the latter of domestic type which have not been made since 1942.

A. L. Smith, of the Division, told the committee that requirements for Class A Stokers for 1944 will total 43,000 instead of the 24,000 originally estimated. One of the significant features of the consumer demand is the large requirement for small-size Class A stokers. Of the originally projected requirement of 24,000 Class A stokers for the year, 12,000 were expected to come from inventory of partially fabricated stokers. These, however, were of the larger sizes, while the demand is for smaller sizes, which cannot be filled from inventory. A canvass of the industry indicated that supplying the demand would require additional allotments of material, castings and fractional motors—the latter two in tight supply.

Plans of OCR to follow through on previous 1AC recommendations that allotments be made for 37,000 Class B stokers during the fourth-quarter brought out the possibility that the time lag required in securing deliveries of motors and castings might enable the industry to produce only 10,000 units during the quarter. Present plans call for authorization of the entire program of 37,000, with the thought that any surplus developing could be carried over into 1945, or serve as a backlog in case reconversion time arrives.

Extended Surface Heating IAC

Members of the Extended Surface Heating Equipment Industry Advisory Committee, meeting August 25 with the Plumbing and Heating Division, also heard their plans for fourth-quarter production conditioned by the current shortage of fractional horsepower motors. Members indicated demands for surface heating units will increase during the fourth-quarter and recommended the allocation of additional material.

Requests were taken under advisement, after discussion of a new Order L-341, placing limitations upon the use of the much-sought motors. Feature of the order is the requirement that users of motors report on Form WPB 3821 their inventories and anticipated need for motors. One purpose of the report is to uncover suspected unbalanced inventories. Members of the 1AC urged that any consideration of such reports recognize the existence of demand for heaters of varied sizes, requiring a reasonable inventory of suitable motors.

Also of interest to the industry is WPB's issuance on August 23 of an amendment to Schedule 1 to Order L-107, requiring the filing by September 4 of a new report on the models and sizes of equipment they wish to produce. It is required that manufacturers report new sizes based on nonferrous metal construction instead of steel construction previously reported. Some copper and aluminum were recently permited for extended surface heating equipment. Since the heat output of non-ferrous metals varies from that of steel, manufacturers will need to change the sizes of equipment they have been producing, WPB officials explained.

A-C Section Not A-C'd

One of the paradoxes of Washington is the fact that the Refrigeration and Air Conditioning Section of the War Production Board staff does not occupy air-conditioned quarters in Washington. In fact, its quarters are in a wing of a building known as Tempo E—the Tempo being an abbreviation of the word "temporary." Another strange thing is that Tempo E was constructed as a "temporary" building during World War I. It almost seems as though the building is more or less permanent, while only peace is temporary.

At any rate, any one who has assumed that his applications for freon for comfort air-conditioning "were probably denied by someone occupying a swanky, air-conditioned Washington office," is wrong. On the other hand, under existing conditions, it may be assumed that the sweltering members of the A-C Section staff signed each denial in perspiration as well as ink.

Give-Aways Blocked

Another Washington sidelight is the OPA's announcement it has authorized local boards to withhold fuel oil rations from anyone who destroys coal or wood-burning equipment, or who sells it or gives it away without good reason, in order to obtain a fuel ration. Heretofore boards have been permitted to revoke outstanding rations only if such other equipment was destroyed or made unserviceable after the ration was issued. The ruling — doubtless to cope with isolated cases of chicanery —required an official amendment No. 21 to Revised Ration Order 11 (fuel oil).

The Office of Defense Transportation is again urging householders, apartment and business building owners and all others needing fuel oil to lay in a supply "now, while deliveries can be made." The shortage of tank trucks and tires, and the mounting demands for military liquid fuels are cited in explanation.

NEWS OF EQUIPMENT AND MATERIALS

Weld Cleaning Tool

NAME—Atlas model A Dual-Tool.
PURPOSE—Weld cleaning tool.
FEATURES — Combined wire bristle brush and slag removing head in one unit. Has improved brush holder for removal of brush, for reversing or replacement by inserting screwdriver at rear end of holder. Every part of tool is replaceable.

MADE BY—*Atlas Welding Accessories Co., 14824 Wyoming Ave., Detroit 21, Mich.*

Liqui-jector

NAME—Liqui-jector.
PURPOSE—For automatically and continuously removing condensate from compressed air and gas lines.
FEATURES—Compressed air entering Liqui-jector passes through the first tube, water-repellent, where it is stripped of moisture; action is by coalescence of dropelets on surface of this tube, made of coarse ceramic material with an average of 50,000 pore openings per square inch, each so small that the pressure drop across the tube is insufficient to permit water passage against resisting diaphragm-action of its surface tension. Coalesced moisture drops to bottom of unit where it passes through second tube, without loss of air, to outside atmosphere. Second tube is constructed of micro-porous porcelain, and, being constantly wet by its wick action, constitutes an air seal up to rated limit working pressure of unit. This rated pressure may be manipulated to user specification. No moving parts are involved and action is entirely automatic. It is and has been found useful in connection with pneumatic tools, gas generators, compressors, spray and blast equipment and other apparatus in which moisture may corrode equipment or damage work.

SIZES AND CAPACITIES—Model A-150-1 illustrated, accommodates lines up to 3/8 in. pipe size with line pressures up to 100 lb per sq in. Larger sizes are being developed.
MADE BY — *Selas Corporation of America, Erie Avenue & D Street, Philadelphia 34, Pa.*

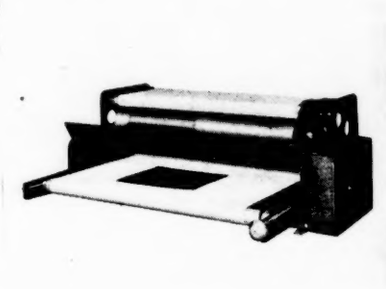
Aircraft Heater

NAME—SRH-15 aircraft heater.
PURPOSE—For heating airplanes.

FEATURES—Device is a new member of the previously announced SRH series. Embodies recently developed combustion process of vapor entraining introduced by T. H. Smoot, vice-president and chief engineer, and utilizes a capillary vaporizing block in conjunction with pre-heated air. Barometric compensation provides for uniform combustion conditions from sea level to 40,000 ft.
SIZES AND CAPACITIES—In shapes to 4 5/8 in. in diameter, 18 3/4 in. long. Weighs 6 lb, 14 oz, including accessories.
MADE BY — *Fluid Heat Division, Anchor Post Fence Company, Baltimore, Md.*

Blue Print Dryers

NAME—Peck & Harvey B-8 Table-type print dryers.
PURPOSE—For overall drying of blue or black and white prints.
FEATURES—Has standard heat regulation, variable speed drive motors and controllers, pressed steel framework, seamless band, seamless copper revolving drum.



SIZES AND CAPACITIES — In 2 sizes handling prints of 26 and 44 in. widths. Current consumption of former is 14 amperes on 110 volts, on latter 23 amperes on 110 volts.
MADE BY—*Peck & Harvey, 4327 Addison St., Chicago 41, Ill.*

Synthetic Insulation

NAME—Nubun.
PURPOSE—Synthetic rubber latex insulation for power, lighting and communication cable.
FEATURES—Material is made from a special modification of buna S synthetic rubber. The makers claim it has flexibility, is impermeable to water, has good di-electric strength and insulation resistance. The compound, it is said, has good aging qualities because of special anti-oxidants, and that it will resist severe wear because of the latex process.
MADE BY—*United States Rubber Co., Rockefeller Center, New York, N. Y.*

Pliastic Cement

NAME—Pliastic cement.
PURPOSE—For joining many combinations of materials.
FEATURES—Cement is synthetic resin adhesive, a soft white fluid used in its natural state or reduced with water. Film when dried is semi-transparent, glossy, flexible, with excellent heat sealing properties.
SIZES AND CAPACITIES—Available in 1, 5, 30 or 55 gallon containers.
MADE BY—*Paisley Products, Inc., 1770 Canalport Ave., Chicago 16, Ill.*

Tubing Couplings

NAME—Self-flaring coupling.
PURPOSE—For flexible plastic tubing.
FEATURES—No flaring tools required. Flare is formed as members of coupling are screwed together in

one simple operation, assuring uniform walled flare, with no thinning toward end to weaken tube. Plastic tubing is not preheated. Construction, by providing a union effect, eliminates twisting and distortion of tubing in installation as well as split ends. Only the simplest of shop tools are required and assembly may be made right at job. Coupling may be reused indefinitely.
SIZES AND CAPACITIES—For tube sizes ¼ in. to ¾ in. O.D.
LITERATURE AVAILABLE — Descriptive catalogs.
MADE BY—*Packless Metal Products Corp., 31 Winthrop Ave., New Rochelle, New York.*

DeVilbiss Smoke Generator

NAME—Land type smoke generator.
PURPOSE—For laying smoke screens.
FEATURES—Generator is mounted on wheels and can be set in operation on landing craft, quickly transferred to beach-head, and moved to any point required.
MADE BY—*The DeVilbiss Co., 300 Phillips Ave., Toledo, Ohio.*

Motor Starters

NAME—ARC magnetic reduced voltage cage motor starter.
PURPOSE—To protect motors from sustained overloads, locked rotor condition, single-phasing and overloading from too frequent starting.
FEATURES—Has accurately calibrated thermal overload relay. Reduced voltage, two-point starting is obtained with a built-in auto-transformer, utilizing accurate, synchronous motor-driven, adjustable timing relay for transition from starting to running position. Units rated through 800 hp have built-in auto-transformers; above 800 hp. auto-transformers are furnished for separate mounting. Interrupting capacity rating of the new starter is ten times the motor's full load current.
SIZES AND CAPACITIES — For motors from 5 to 2500 hp up to 5000 volts, 3 phase, 50 or 60 cycles.
MADE BY — *Allis-Chalmers Mfg. Co., Milwaukee, Wisc.*

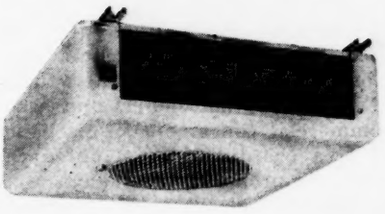
Flow Rate Alarm

NAME—Rota-Sight flow rate alarm.
PURPOSE—For visible and audible protection against dangerously low or high rates of flow of liquids and gases.
FEATURES—Device operates through a float which moves up and down a Pyrex tube into which triangular flutes have been fashioned. As float rises, area within flutes increases, causing float to assume a position in tube in direct proportion to flow

rate. A magnetic extension on float trips an external switch to operate alarm circuit. Alarm flow point is adjustable over entire flow range and operates accurately at set position. Used for flows of water, lubricating oils, filter feeds, overflows, chemical additives.
SIZES AND CAPACITIES—Up to 2½ in.; may be obtained in any corrosion resistant material that can be cast.
LITERATURE AVAILABLE—Bulletin 92-B.
MADE BY—*Fischer & Porter Co., Hatboro, Pa.*

Air Coolers

NAME—Spasaver air cooler.
PURPOSE — Ceiling type horizontal unit cooler for cold rooms, large refrigerators, and other similar uses.
FEATURES—Housed in streamlined white enamel cabinets, suitable for all refrigerants and ready for installation. Equipped with new type propeller fans, units operate at low



noise level. Coils are of the fin and tube type, equipped with company's kinetic type refrigerant distributor. Motors are slow speed totally enclosed ball bearing, 115 volt, single phase, 60 cycle, requiring no lubrication after leaving factory.
SIZES AND CAPACITIES—10 different sizes.
LITERATURE AVAILABLE—Catalog with specifications and performance data.
MADE BY—*Drayer-Hanson, Inc., 738 East Pico Street, Los Angeles 21, Calif.*

Templar Colored Pencils

NAME—Templar indelible colored pencils.
FEATURES—Water soluble, with intensely strong leads. Can be used either dry or with water for map and chart coloring and other drawings. Not only are the leads unusually tough but additional strength has been imparted by a new process of bonding lead and wood, making a solid unbroken unit. Ideal for wash effects. Available in a wide range of colors at stationers. Samples obtainable by writing on letterhead to manufacturer.
MADE BY—*Reliance Pencil Corp., Mount Vernon, N. Y.*

Portable Electric Unit Heaters

NAME — Portable type Electromode unit heaters.
PURPOSE—For heating specific areas.
FEATURES—Heating elements used are of patented Electromode construction with sheathed resistor sealed in a one-piece finned aluminum casting with the motor-driven fan mounted directly behind the elements. Heater was developed for use in control and generator rooms for a number of TVA power stations.
MADE BY—*Electric Air Heater Company, Division of American Foundry Equipment Co., Mishawaka, Ind.*

NEWS OF THE MONTH

Fuel Conservation Program Speeds Up

WASHINGTON.—As the National Fuel Efficiency Program gained additional momentum, the Bureau of Mines of the Department of the Interior on August 20 named 42 new area coordinators in 24 states to cooperate with 5,000 volunteer regional engineers in heading off a possible fuel crisis this winter through the conservation of coal, gas, petroleum, and wood by industrial and commercial consumers. This brings to 143 the number of area coordinators appointed throughout the Nation since the program was inaugurated several months ago.

Indicative of the interest in fuel conservation shown by large-scale consumers, one area coordinator alone has received assurances from approximately 1,000 plants that have pledged whole-hearted cooperation in the campaign started by the Government with the advice and assistance of industry. These plants have agreed to consider fuel-saving recommendations applicable to their particular operations.

Asserting that participation in the program will help speed victory, Secretary of the Interior Harold L. Ickes said that the counsel given free of charge by the volunteer engineers will not encroach upon the activities of commercial firms which provide technical advice and the services of consulting engineers in redesigning or making replacements in plants.

Coordinators, regional engineers and "waste chasers" gather information and conduct careful check-ups in heating plants of factories, apartment houses and office buildings to disclose practices resulting in an abnormal consumption of fuel or any heat waste in industrial utilization. Owners and operators are advised immediately regarding suggested measures to combat waste. One small hotel is reported to have saved 500 barrels of fuel oil during the past six months by improving the efficiency of its heating plant on the advice of engineers of the National Fuel Efficiency Program.

Information pertinent to equipment, supplies and modern power plant practices developed by the Bureau of Mines in conjunction with industry groups has been passed on to coordinators, regional engineers, and waste chasers for use in the program. Eventually, about 100 subjects will be covered, but the special information made available to date includes the following:

Coal Handling and Storage; Boilers (all types and capacities); Stokers (industrial and commercial); Gas and fuel oil in commercial and industrial applications; Instruments—control, recording, measuring; Heat utilization and distribution; Fans, filters, air recirculation and purification; Insulation; Exhaust steam utilization, and control of miscellaneous energy losses.

A. C. Demanded for Post-War Coaches

NEW YORK—Air conditioning is one of the features of coach train travel most desired by five thousand New York Central passengers who responded to a questionnaire dealing with proposed designs of post-war coach trains.

Men named air conditioning as the most important factor in travel comfort, according to results of the survey made public July 4 by F. H. Baird, New York Central general passenger traffic agent.

The men agreed on a temperature of 74F except in extremely hot weather, when they preferred that the controls be set to vary car temperatures with outside temperatures.

Hard Coal Utilization Studied

PITTSBURGH—New methods for utilizing small sizes of Pennsylvania anthracite are being studied by the Bureau of Mines, J. F. Barkley, Chief of the Bureau's Division of Solid Fuels Utilization for War, said in a paper presented before the American Society of Mechanical Engineers at the Society's semi-annual meeting here in June.

A four-point research program, intended to relieve a growing surplus of these supplies and stretch the supply of vitally needed bituminous coal by supplementing it with anthracite where possible, is being conducted, Mr. Barkley said.

The speaker said that the growing surplus of the industrial sizes of anthracite — the smaller sizes — threatens to cut sorely needed production of domestic sizes unless new markets can be found. To help move the smaller sizes of anthracite, surplus tonnages now are being purchased by the Defense Supplies Corporation of the Government and are being marketed through the Solid Fuels Administration for War and his divisional offices.

In his speech before the fuels section Mr. Barkley said the Bureau's research program involves the experimental burning of mixtures of small anthracite and bituminous slack on stokers, studies of the methods of producing and burning "packaged fuels" made from anthracite fines, the use of anthracite fines in the production of coke, and the use of barley anthracite in gas producers. The problems are being studied cooperatively with industry.

Tests in the burning of proper mixtures of small anthracite and bituminous slack on stokers have revealed thus far that this fuel generally is as good as bituminous coal, Mr. Barkley said.

"The percentage of anthracite that should be mixed with bituminous coal for a given installation depends on many factors, such as the availability of needed amounts of bituminous coal, the load to be carried, and the type of equipment," he added. "It should be determined by trial for each installation. Appropriate stoker and damper adjustments for the changed burning characteristics of the fuel also must necessarily be determined on such trials."

With the aid of a large industrial concern the Bureau is experimenting with the production and testing of packaged fuel containing bituminous coal and various percentages of anthracite fines. This phase of the Bureau's research is directed by William Seymour, Bureau chemist and co-author of the paper read by Mr. Barkley. Trial runs have been made and the tests are continuing. Mr. Barkley said that some preliminary tests by a manufacturer of packaged-fuel equipment for small producers indicate that a satisfactory product can be made from anthracite fines mixed with 10 or 15% bituminous coal and a starch binder.

U. S. Steel Completing Greatest Mine

NEW YORK—The United States Steel Corporation announced recently that its subsidiary, the H. C. Frick Coal Company, is now pushing to completion the development of a new mine at Robena, in Greene County, Pa., which will be the largest bituminous coal producer in the world. It will have a daily output of 20,000 tons of washed coal when fully developed.

Preparation of the underground network of shafts has resulted in a recent daily production of 4,000 tons of coal

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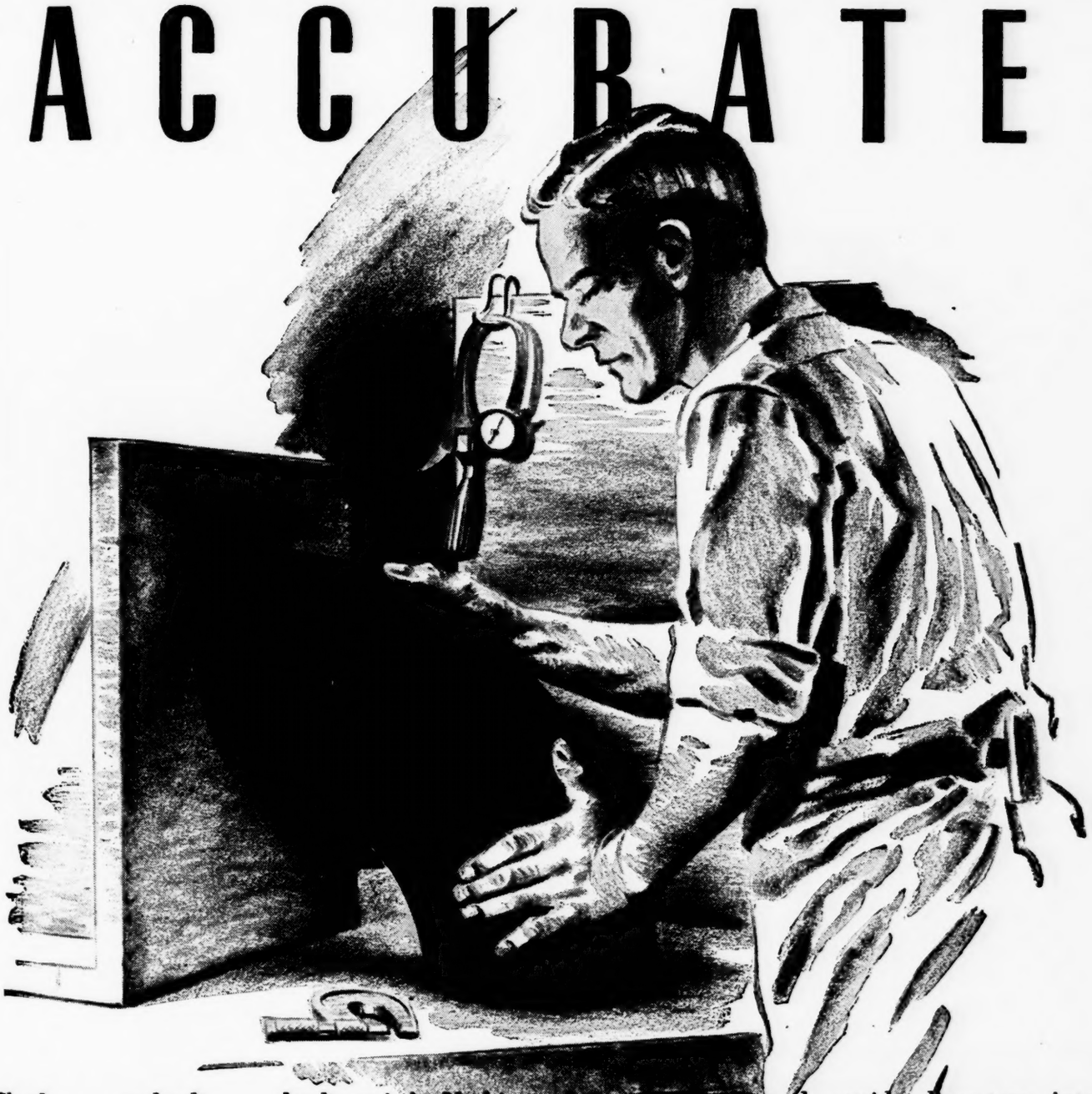

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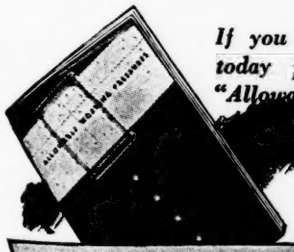

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News of the Month

Big Inch Completes Year of Service

WASHINGTON.—The world's biggest oil pipeline, the 1,363 mile Big Inch line from Longview, Texas, to the New York-Philadelphia area, began its second year of full-length operations August 14, having delivered some 96,292,000 barrels of crude oil from the Texas fields to eastern refineries during the last 12 months.

Designed to pump crude oil at the rate of 300,000 barrels daily, Big Inch has consistently exceeded this rate since all pump stations were put into operation. In July, a daily average of 314,134 barrels was pumped through the line. The daily average for the last 12 months was 263,000 barrels despite the fact that all pump stations did not operate during the entire year.

Highest pumping rate was recorded on June 12 when 326,332 barrels of crude oil were pumped through the line to the East Coast.

The line holds approximately 4,000,000 barrels of oil, a reservoir of oil moving eastward at the rate of approximately 100 miles a day.

PHIB 25 Years Old

CHICAGO.—This year marks the 25th anniversary of the founding of the Plumbing and Heating Industries Bureau. To commemorate this event, The Central Supply Association is giving a dinner in connection with its annual fall convention at the Palmer House, October 26-27. The silver anniversary dinner in honor of the Bureau will be given in the Red Lacquer Room, Thursday evening, October 26.

All members of the plumbing and heating industries will be welcome at the dinner, according to Walter Reichle, president of The Central Supply Association. An outstanding speaker whose name will be announced later will address the dinner meeting.

Competition on Basement Designs

NEW YORK—An architectural competition has been announced by Bituminous Coal Institute for the most attractive and practical designs permitting heating with any major fuel. The Institute is offering $4,750 in War Bonds in the competition, open to architects, engineers, designers and draftsmen "to design the basement of a house in such a way that it shall be most useful, convenient, efficient and attractive." The program of the competition specifies that "the design shall include provision for 'flexible heating'—that is, for the use of any major fuel." The contest will close November 15.

Kenneth K. Stowell, editor of *Architectural Record*, is serving as professional adviser. Following the judging, winning designs will be published, with credit to the designers. These designs will show to builders and prospective house buyers the most practical, useful and ingenious ideas in modern basement planning.

Further information is available from the Institute, 60 E. 42nd St., New York 17, N. Y.

Air Conditioned Trolley Postponed

ATLANTA, GA.—Proposed experimental installation of air-conditioning equipment in a trackless trolley, which had been planned by the Georgia Power Co., for trial here during August, was postponed until next summer because of war priorities. The experiment will be conducted next summer to determine whether the machinery will work in such a vehicle, and whether results will justify the expense involved.

Joseph W. Kling of the power company announced that the manufacturer of the experimental unit had received a large order for air-conditioning equipment for naval vessels, and would not be able to deliver the unit until some time next winter.

Post-War Public Works Surveyed

WASHINGTON—Information is being asked on all types of public-works construction planned for after the war, in a country-wide survey made by the House Committee on Post-War Economic Policy and Planning, Representative William M. Colmer of Mississippi, chairman of the committee, said in an interview July 22.

The survey is being conducted by the Federal Works Administration and has been addressed by Maj. Gen. Philip B. Fleming, Federal Works Administrator, to governors, county executives and mayors of cities of more than 10,000 inhabitants.

The survey will cover four stages of plan preparation, ranging from projects for which bids could be advertised and contracts awarded within sixty days, to projects in the idea stage where construction is contemplated before 1950. Data will be assembled on nine types of projects to include only new construction, reconstruction and improvements involving public works facilities other than Federal. The governors, mayors and county executives have been asked to report what funds or reserves have been set aside for financing post-war public works or the probable sources for financing them.

Types of projects embraced in the survey are as follows:

1. Highways, roads and streets, including culverts.
2. Bridges, viaducts, grade separations.
3. Airports, terminals and landing strips, airport buildings and other airport and airway facilities.
4. Sewer, water and sanitation facilities.
5. Schools, including dormitories, auditoriums, gymnasiums, libraries and administrative building.
6. Hospitals, including clinics, health centers, sanitariums, and public health buildings.
7. Such public buildings as city halls, court houses, police and fire stations, garages, storage buildings, armories, institutional and community buildings.
8. Parks, including playgrounds, athletic fields, stadiums, grand-stands, fair grounds, tennis courts, golf courses, swimming pools, band shells, outdoor theatres and recreational buildings.
9. Miscellaneous public facilities not included in above, such as public gas and electric plants, public transportation facilities, docks, wharves, breakwaters, irrigation systems other than Federal projects.

A. C. for Army Hospital Ships

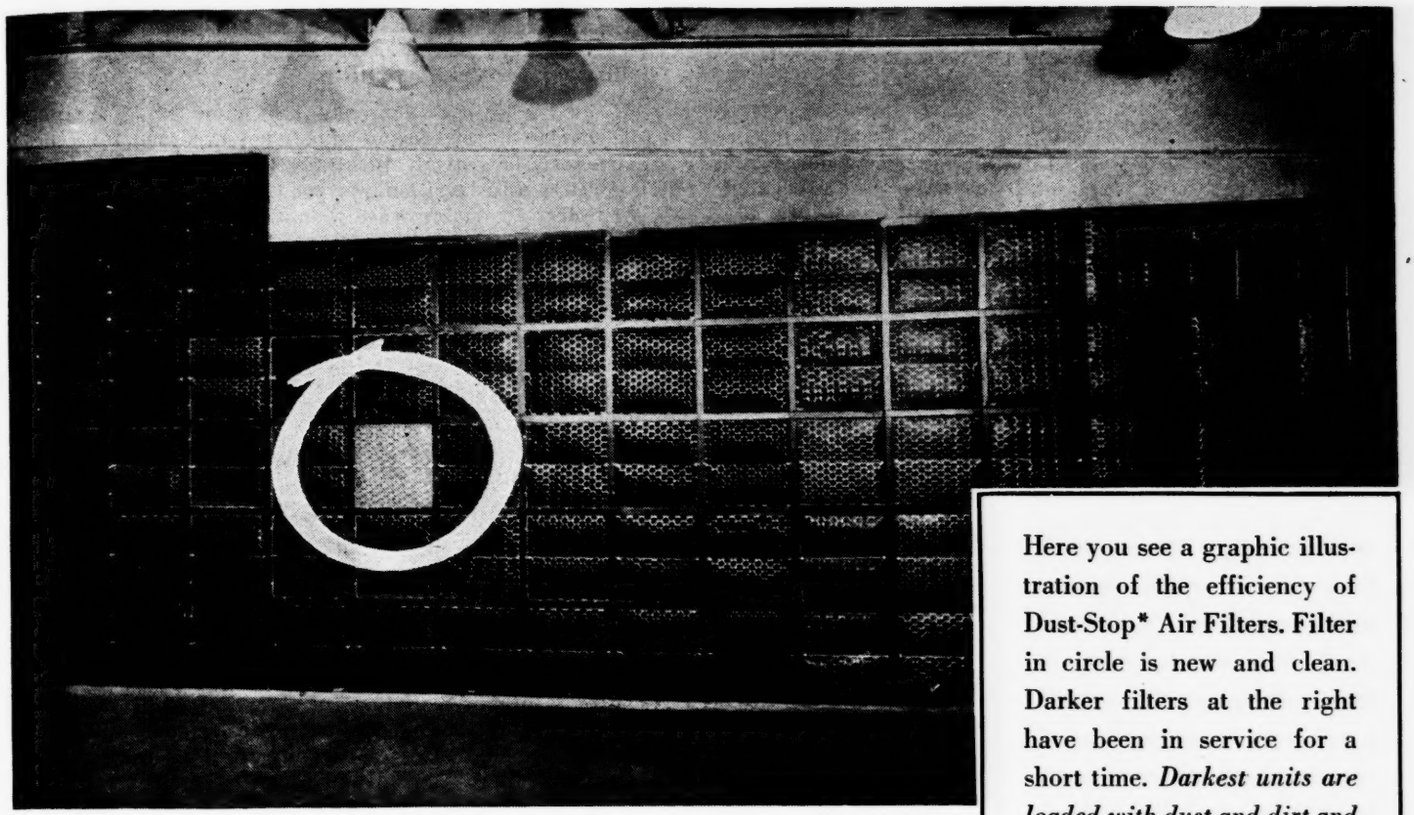
CHICAGO—Twelve ventilating systems and complete air conditioning for operating rooms are built into the army's newest hospital ship, the *USS Marigold*, formerly the liner *President Fillmore*. Four other new hospital ships are being fitted out with the same type of equipment.

Mindful of the ill-ventilated, uncomfortable and depressing hospital ships of the last war, Army engineers, who directed the *Marigold's* conversion, put the welfare of battle casualties ahead of all other considerations and equipped the ship with the twelve separate ventilating systems. Temperature and humidity in the patients' and crew's quarters are now under control.

The two operating rooms, completely air conditioned, have a particularly elaborate Johnson Service heat control system, with summer-winter change-over thermostats to control both the dry and wet bulb temperatures.

A temperature of 75F and humidity of 55% are maintained whenever the air conditioning system is operated on the heating cycle. When cooling is required, the control apparatus maintains a certain pre-determined temperature difference between the outdoor temperature and the temperature in the operating room.

ABRASIVE SABOTEURS TRAPPED !



Here you see a graphic illustration of the efficiency of Dust-Stop* Air Filters. Filter in circle is new and clean. Darker filters at the right have been in service for a short time. *Darkest units are loaded with dust and dirt and obviously need replacing.* They have served their purpose — prevented abrasive saboteurs from entering the motor and generator room of the large steel plant where this extensive installation is located.

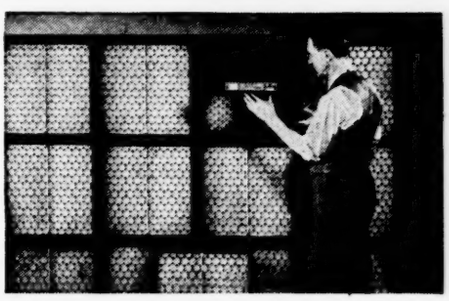
Put Fiberglas* Dust-Stops on your plant protection pay roll.

Dust-Stops are constructed of packs of glass fibers coated with an adhesive, faced with punched metal grilles and bound on the edges with a fiberboard frame.

The Fiberglas filter medium is coated with a nonodorous, nonevaporating adhesive having extraordinary wetting power. Each impinged particle of dust is quickly soaked . . . acts as a wick to carry adhesive to other particles striking the first. Thus, the adhesive remains effective until the filter is so heavily coated with dust that resistance to air flow calls for replacement.

Because of their low cost and ready availability from suppliers in every community, Dust-Stops that have done their job can be easily and economically replaced.

For complete information on Dust-Stops and their many uses, write: *Owens-Corning Fiberglas Corp., 1912 Nicholas Building, Toledo 1, Ohio. In Canada, Fiberglas Canada, Ltd., Oshawa, Ont.*

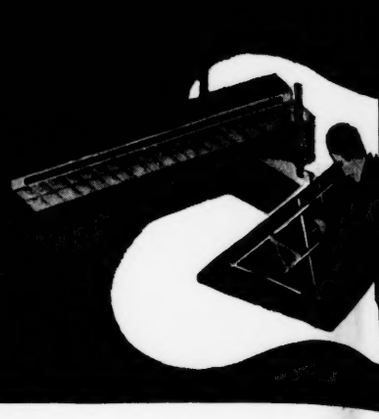


Dust-Stops for central systems comprise individual parts for each cell; steel frames, bolts, nuts, gaskets and filters—complete and ready for assembly.

DUSTOP* **AIR FILTERS**

*T. M. REG. U. S. PAT. OFF.

REVIEWS



HEAT TRANSFER

Special media for heat transfer are discussed. Gases are not media, due to low heat capacity and poor convection characteristics, but frequently no adequate substitute is available. Air and flue gases are used commonly.

Water is the ideal liquid medium for temperatures from slightly above freezing to about 450F. A petroleum oil fraction has been used for the range 300 to about 550F. Dowtherm A liquid is used in both heating and cooling processes. For temperature above 700F, molten inorganic salt mixtures are used. A mixture known as H.T.S. consists of sodium nitrate, sodium nitrite, and potassium nitrate. Melted lead, tin, sodium, and several low melting alloys have been used to a limited extent. Liquid coolants for use at temperatures below the freezing point of water include aqueous solutions of ethanol, methonol, the ethylene glycols, glycerol, glucose, sodium chloride, and calcium chloride.

Condensing vapors of water or Dowthern A are adequate for temperatures up to 700F. Mercury vapor has been used in the 400 to 1000F range, but is apparently being replaced by less expensive media.

Heat transfer between finely divided solids and the gases in which they are suspended has been employed recently. This principle is applied in Standard Oil Co. of New Jersey process for petroleum cracking with so-called "fluid" catalysts.

"Special Media for the Transfer of Heat," editorial staff, Chemical and Metallurgical Engineering, 51, No. 5, 118-9 (May, 1944).

COAL ANALYSES

A comprehensive report giving analyses of Virginia coals tested during the past 30 years has been published by the Bureau of Mines to help wartime consumers of coal find suitable types of fuel and to augment the Government's store of technical knowledge of coals throughout the United States. Since 1921, the Bureau has analyzed and published detailed information on the coals in 21 states. The latest report on the coals of Virginia—the first state in the Nation to mine coal—represents the work of the Bureau of Mines, the Geological Survey, and the Solid Fuels Administration for War, all of the Department of the Interior.

Virginia ranks as seventh in the production of bituminous coal. Coal samples for which analyses are given were taken in mines, at tipples during loading for market, and at delivery points for Government purchases of fuel. A valuable reference aid, the report describes the geology of Virginia coal fields, mining methods, coal preparation, production, distribution, and use, and other pertinent facts regarding the industry and its products. A map of Virginia coal fields and plans of mine developments are included.

Of particular interest to coal consumers are the analyses of various sizes of Virginia coal shipped to market. These analyses usually are given by individual mines and thus provide the consumer with sufficient information so that his coal purchases can be made intelligently and without guesswork.

Copies of Bureau of Mines Technical Paper, 656, "Analyses of Virginia Coals," are obtainable through the Superintendent of Documents, Government Printing Office, Washington 25, D. C., at 15 cents per copy.

INSULATION FOR SHIPS

From the ship owner's point of view, the insulation for marine refrigeration must possess the following characteristics: High insulating value; light weight; flexibility and resiliency; good structural strength; resistance to deterioration and disintegration; impervious to moisture; resistance to infiltration of air; fire resistant or fireproof; odorless; not conducive to harboring vermin or rodents; reasonable in cost, and workable in construction.

While it is impossible for one type insulation to possess all these characteristics, the list is the yardstick by which insulation is judged by practical ship owners.

"The Ideal Insulator for Shipboard Use," L. L. Westling, Refrigerating Engineering, June, 1944, 459-60.

COMFORT AIR CONDITIONING

The basic data necessary for calculation of load requirements for comfort air conditioning is given in Part IV of the 4th Edition of the Engineering Standards of the Heating, Piping and Air Conditioning Contractors National Association.

The pamphlet contains the definitions of terms used in discussing air conditioning and examples showing the application of psychrometric relations, and also showing the method of calculating the load for comfort air conditioning. Charts and tables give the necessary data on which these calculations are based. The pamphlet brings together in one place the material which the engineer needs for his work and presents it in a handy and easily used form.

Previously issued parts of this series were I—Heat Loss Calculation, and II—Low Pressure Heating Boilers. Part III has not yet been published.

Copies of the pamphlet can be obtained from the Heating, Piping and Air Conditioning Contractors National Association, Room 1401, 1250 Sixth Ave., New York 20, N. Y., at $1 per copy.

REFRIGERATION AS A LOAD BUILDER

Utilities look upon refrigeration with favor, for as cooling grows, so will the utility load. Generally, small domestic and commercial refrigeration loads afford a fine load factor. Large applications such as ice plants, breweries, storage plants are also desirable.

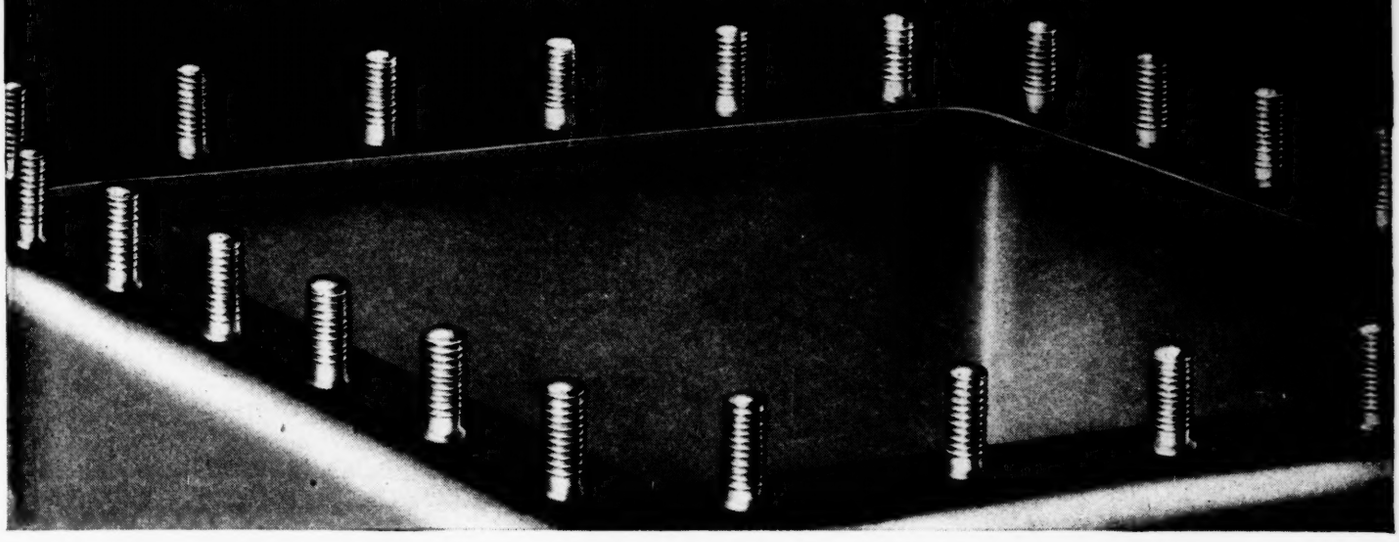
The off-peak load is generally attractive to the utility, and in this class, there is the refrigeration storage plant where the cooling effect is accumulated at night and is used during the day. It is less attractive if it requires expensive transmission equipment.

While summer air conditioning provides the most potential market for refrigeration, it affords little diversity for the utility and most applications are designed for continuous operation at normal peak loads. During hot weather, all air conditioning plants would be operating to produce a simultaneous peak load.

Utilities would welcome developments that would make use of the off-peak or storage reserve. It would like to see further use of reverse cycle heating and more storage refrigeration.

"The Future of Refrigeration from the Standpoint of the Utilities," John de B. Shepard, Refrigerating Engineering, June, 1944, 449-51.

How to automatically end-weld studs . . .

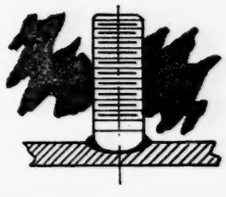


DON'T!

Don't waste both time and material using bolts for studs. Drilling holes, placing the bolt, and hand welding is wasteful. Why do all this when a method saving up to 75% of your time and material cost will produce work that is more accurate, stronger, and leak proof. *Here's the way Nelson Stud Welding will help you:*

DO!

Do use Nelson Stud Welding, because no holes need be drilled . . . it's all done in one operation *automatically!* Complete fusion between stud and metal is made easily and quickly. And the weld is stronger than the strength of the stud. Used today in more than 400 industrial plants in the United States and Canada, the Nelson Stud Welder may be operated either manually or as a production unit.



SEE US AT THE METAL CONGRESS OCTOBER 16

WRITE TO:

NELSON SPECIALTY WELDING EQUIPMENT CORP.

Dept. H, 440 Peralta Avenue, San Leandro, Calif.

Eastern Representative: Camden Stud Welding Corp. Dept. 22, 1416 So. Sixth St., Camden, N. J.

The Model "H" Stud Welder

NELSON

STUD WELDERS & STUDS

TUBE DATA BOOK

A comprehensive, loose-leaf data book on seamless steel tubing, divided into four principal sections, with guide index, covering General Data, Mechanical Tubing, Pressure Tubing, and Reference Tables.

Under General Data there is a brief summary on the history, manufacture, tests, special shapes and standard steels with chemical composition, mill practices, etc.

The section on Mechanical Tubing covers information on typical uses, suggestions of how to obtain best results through the use of tubing, determining proper size, with complete tolerance tables, properties for beams, and a digest of standard specifications.

The section on Pressure Tubing covers various pressure formulae, specifications and tolerance tables for boiler tubes, heat exchanger and condenser tubing, still tubes, alloy steel pipe, stainless steel analyses, with metallurgical data.

The Reference Table section is unusually extensive with many formulae, weight tables for rounds, squares, rectangles, surface areas both inside and outside, and other tables commonly found useful in tubing applications.

This is the most complete volume on this subject issued for many years. Supplementary sheets with new data will be supplied from time to time.

Published by Seamless Steel Tube Institute, Pittsburgh 19, Pa. 320 pages, loose-leaf binder; page size 8 1/2 x 11 in. Price, $2.50.

HEAT TRANSFER

Tables and nomographs are presented for obtaining values of film coefficients for liquids, gases, condensing vapors, and boiling liquids.

"Heat Transfer: Conduction, Radiation and Convection," Herman J. Stoever, Chemical and Metallurgical Engineering, 51, No. 5, 98-107 (May 1944).

BRIEF REVIEWS

THERMODYNAMIC CHARTS.—The second edition of a book entitled "Thermodynamic Charts" by Professors Frank O. Ellenwood and Charles O. Mackey, both of Cornell University, and including 23 full page charts on steam, two on water, two on low quality steam, three on ammonia, two on Freon-12, and three psychrometric charts, together with examples showing use of the charts, and a number of pages of tabular material. The form of presentation with the charts on separate pages in book form rather than a single large folded sheet has proved highly satisfactory. The second edition embodies corrections of errors that have been noted in the first edition and also some modifications and additions. Published by John Wiley & Sons, Inc., 440 Fourth Ave., New York, N. Y. Cloth bound, 8⅜ x 11⅛ in. in size. Price, $2.75.

HEATED CLOTHING.—An 18-page, multilithed paper, including 13 illustrations and entitled "Electrically Heated Clothing," by G. H. Wotring, General Electric Co., presented before the American Institute of Electrical Engineers, 29 W. 39th St., New York. The paper gives the historical background of this type of apparel, developed originally for flyers; descriptions of the development and theory back of the clothing; outlines the advantages and disadvantages; gives total heat requirements, determination of heating requirements, and discusses cold room tests, types of controls, and the future of such clothing.

BUILDING MONEY.—In preparation for the residential repair and modernization work expected when wartime restrictions can be eased, the Federal Housing Administration has issued a booklet for building material dealers and contractors. The booklet, which will aid in carrying out new Title I regulations effective July 1, 1944, is entitled "Here's How to Make Sales and Satisfied Customers with FHA Title I Loans," and is being distributed through qualified lending institutions to dealers who originate Title I property improvement loans in connection with their sales. The booklet was produced with two purposes in mind, according to FHA officials. First, it aims to give the dealer, in handy reference form, essential operating facts he needs to know in order to originate property improvement loans which are eligible for discount by a lending institution and for FHA insurance. Second, the booklet seeks to show what FHA expects of dealers who participate in its property improvement program. Available from FHA, Washington, D. C.

CLIMATE.—S. F. Markham's "Climate and the Energy of Nations" reviewed on these pages in November, 1943, has now been issued in an American edition by the publisher, Oxford University Press. Publisher reports that the first edition of the book in England sold out its first printing in less than a month. It has now been extensively revised and enlarged; three new chapters have been added dealing with climate and energy in the United States. Published by the Oxford University Press, 114 Fifth Ave., New York 11, N. Y. Cloth binding, 236 pages, size 5¾ x 8½ in. Price, $3.50.

SPONTANEOUS COMBUSTION.—A 12-page pamphlet entitled "Spontaneous Combustion and Its Prevention" by Edward A. Dieterle, consulting engineer, Chicago, and reprinted from the *Journal of The Western Society of Engineers*. While the spontaneous combustion of coal is adequately treated, a feature of the pamphlet is the section on spontaneous heating of materials other than coal, and means of prevention.

CORROSION.—A multilithed 42-page standard size report R.I. 3754 entitled "Observations on the Use of Cyclohexylamine in Steam-Heating Systems" by A. A. Berk. Published by the U. S. Department of the Interior, Bureau of Mines. Available from the Superintendent of Documents, Washington, D. C.

BRIQUETS—A 17-page mimeographed report entitled "Fuel Briquets and Packaged Fuel in 1943," Mineral Market report No. 1175 of the Bureau of Mines. Report, primarily statistical, shows that there was sharply increased production of fuel briquets in 1943 but a sharp decrease and shutdown of 29 plants in the packaged fuel industry. The latter were severely handicapped by shortage of labor, fuels, and paper. Available from the Bureau of Mines, Washington, D. C.

ANTHRACITE.—A 30-page mimeographed report entitled "Pennsylvania Anthracite 1943" giving statistical information on data relating to trends, consumption, production, and sales. Published as one of the Mineral Market Reports by the U. S. Department of the Interior, Bureau of Mines. Available from the Superintendent of Documents, Washington, D. C.

COKE.—A 30-page multilithed and statistical report on coke and by-products, published as a Mineral Market Report No. 1219 by the Bureau of Mines, Washington, D. C.

SIZING JOB-MADE LIQUID-VAPOR HEAT EXCHANGERS

This sheet is a companion to Reference Data 275-276 and use of the accompanying charts is explained on that sheet.

The charts were designed by William Parkerson, Central Power and Light Company, Victoria, Texas.

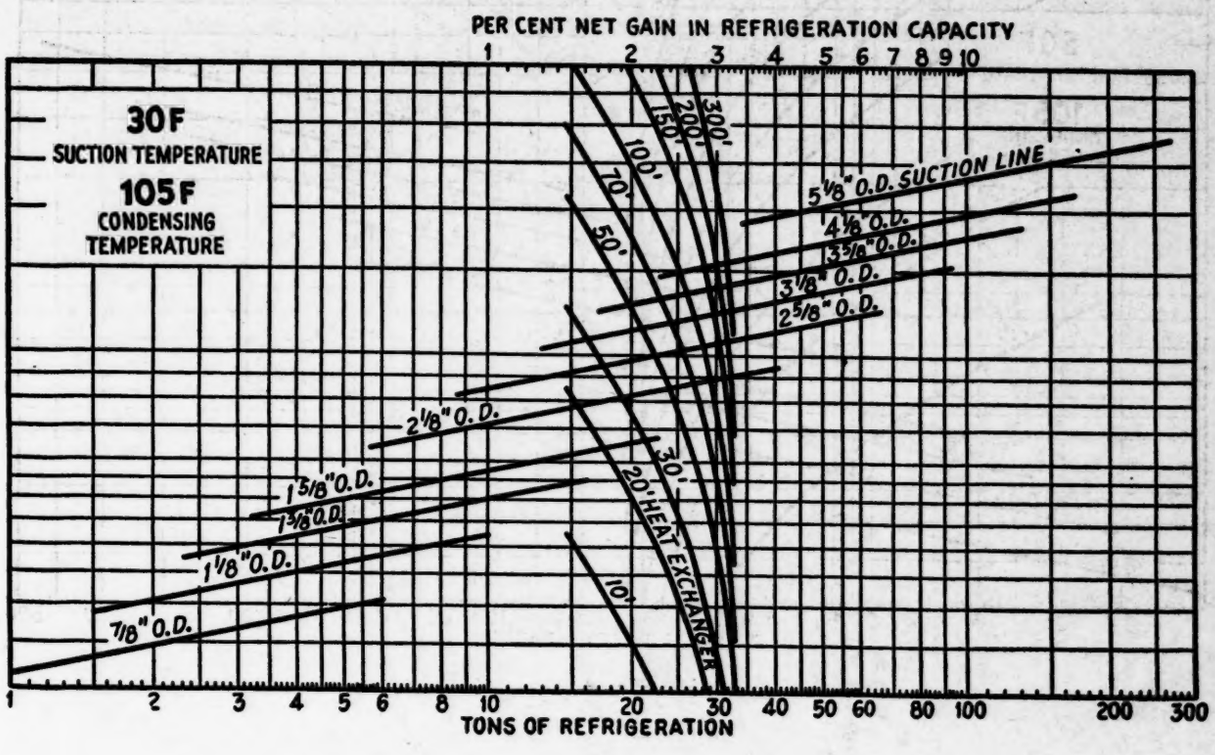


Fig. 4

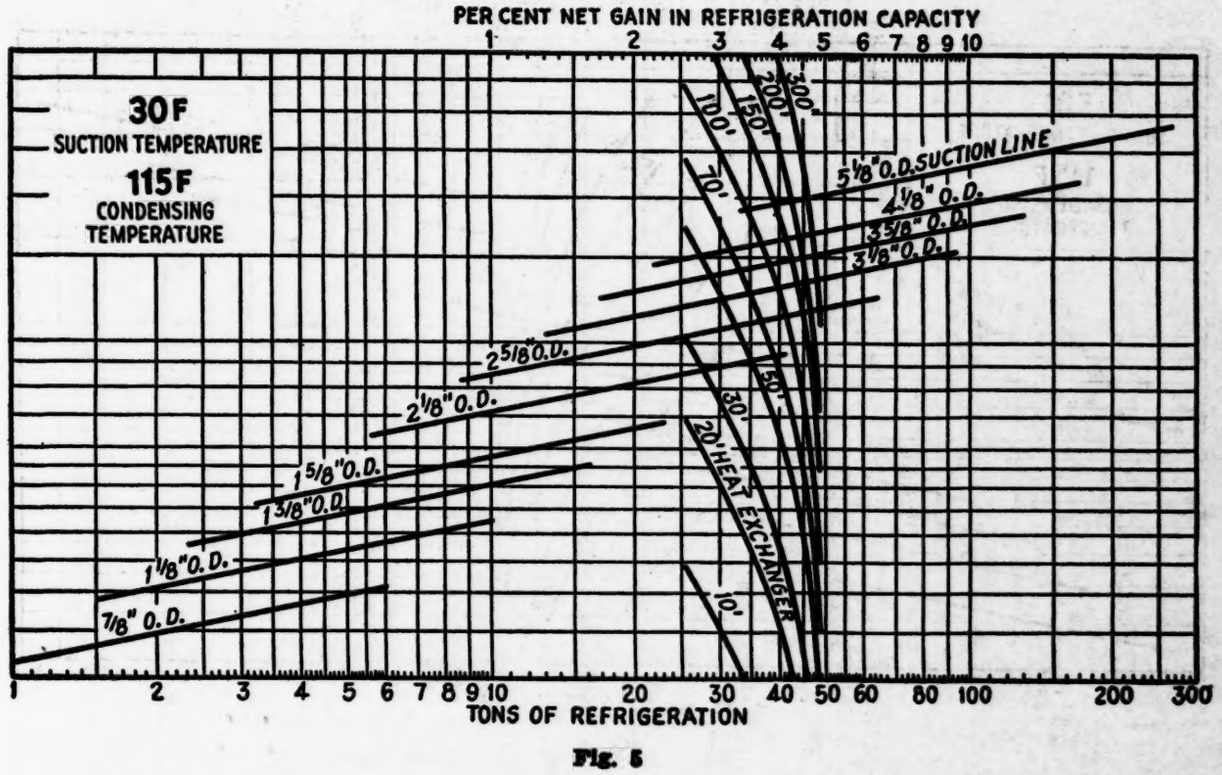


Fig. 5

Published by HEATING AND VENTILATING, *148 Lafayette St., New York.* *9/44.*
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SIZING JOB-MADE LIQUID-VAPOR HEAT EXCHANGERS

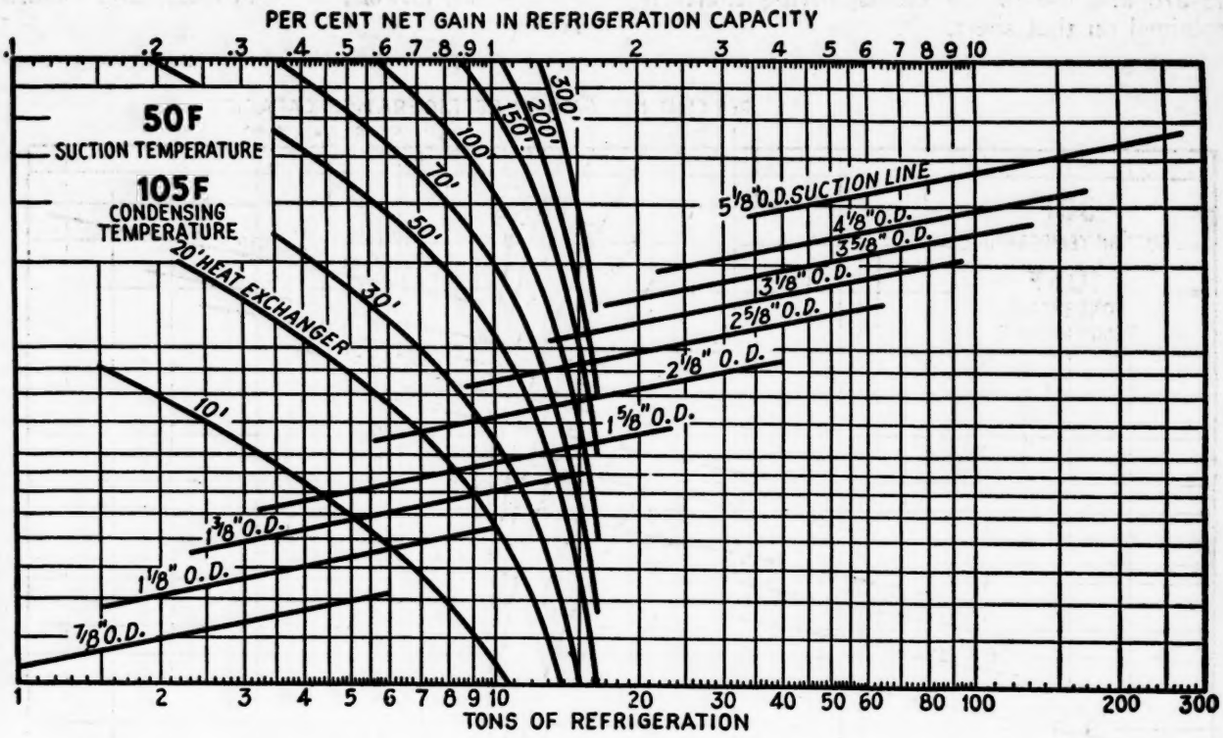


Fig. 6

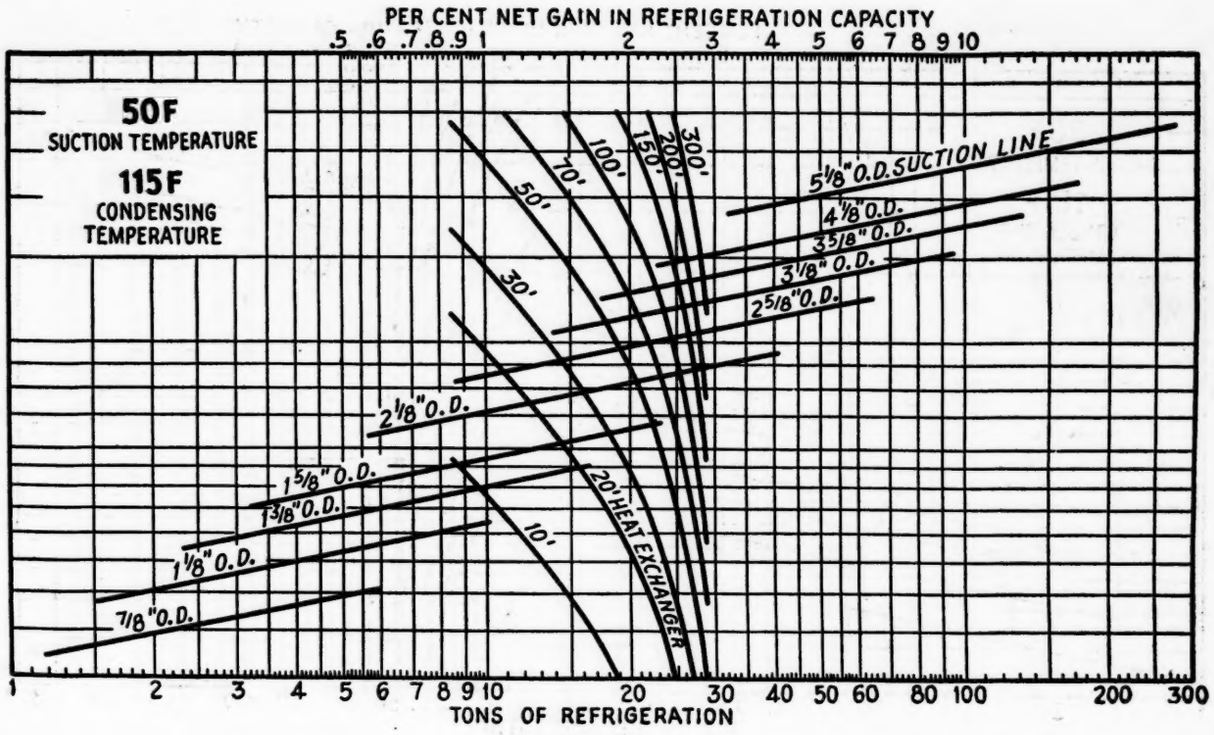
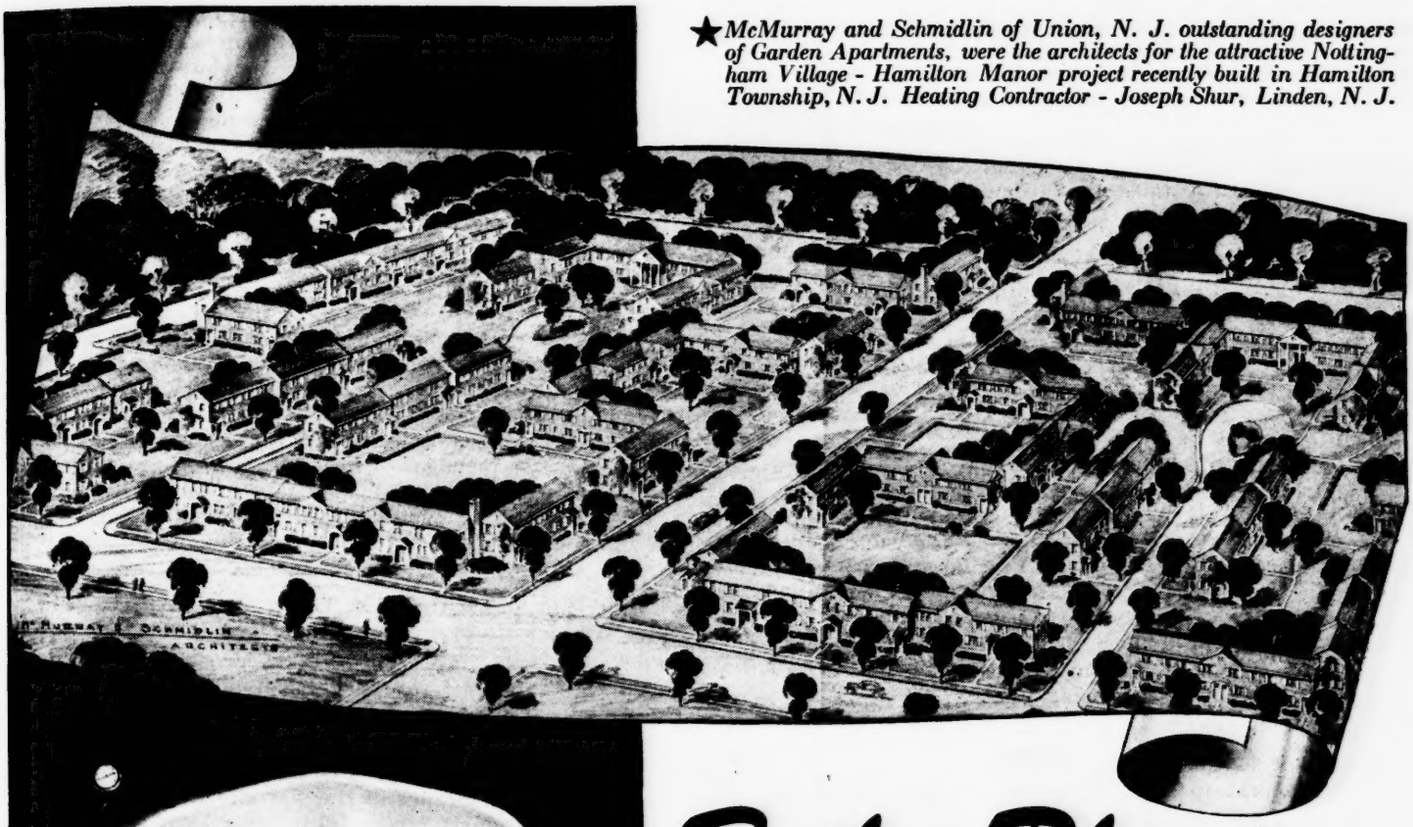
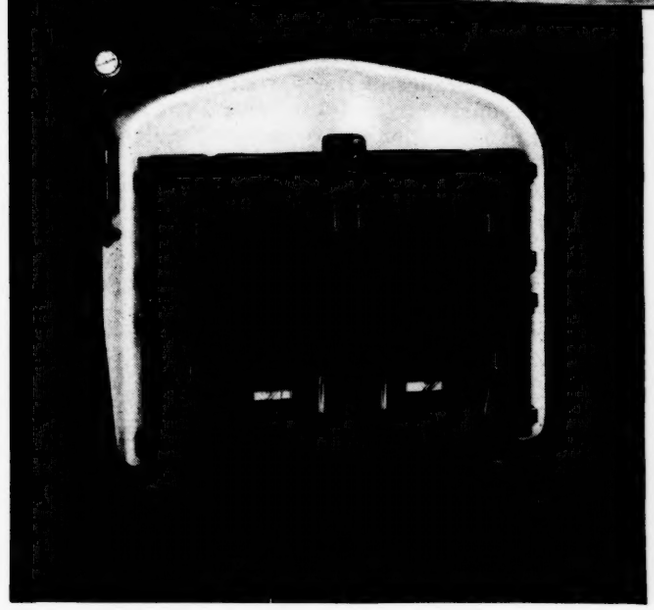


Fig. 7

Published by HEATING AND VENTILATING, *148 Lafayette St., New York.* *9/44.* *Copyright, 1944, by* THE INDUSTRIAL PRESS.



★*McMurray and Schmidlin of Union, N. J. outstanding designers of Garden Apartments, were the architects for the attractive Nottingham Village - Hamilton Manor project recently built in Hamilton Township, N. J. Heating Contractor - Joseph Shur, Linden, N. J.*



44 MILLS BOILER FOR STOKER

Boiler Plant...

FOR THE POST-WAR

GARDEN APARTMENT

The best in permanent war housing construction is well exemplified by the series of New Jersey Garden Apartments designed by architects McMurray and Schmidlin of Union, N. J. These attractive buildings erected in 1942 and 1943 are equal to any pre-war apartment groups both in design and utility.

The heating systems are of particular interest as their advanced design forecasts the trend of apartment house heating in the post-war years. The twin Nottingham Village - Hamilton Manor project shown above, for example, is heated by one-pipe forced hot water systems. There are six strategically located boiler plants containing eight H. B. SMITH #44 Mills stoker fired boilers. These cast-iron, independent header type boilers not only are operating efficiently and economically but will pay additional dividends to their owners in lowered maintenance expense throughout their long, long lives.

Specifiers and installers, who will be judged by the operation of the equipment they recommend, will do well to profit by these war time experiences and specify a known quantity in boiler performance . . . H. B. SMITH.

H.B. *Smith*

CAST-IRON BOILERS

THE H. B. SMITH COMPANY, INC. • WESTFIELD, MASS.

Branch Offices and Sales Representatives in Principal Cities

. . . Since the Last Issue

S. W. Fletcher

S. W. Fletcher, for many years executive vice-president of the **J. O. Ross Engineering Corporation,** has been elected president of that company and will continue to make his headquarters in New York. **A. E. Montgomery** will continue as vice-president, with headquarters in Chicago. Other officers are: vice-presidents, **H. G. Rappolt** and **F. W. Partsch;** treasurer, **J. A. Ronder;** secretary, **R. W. Grott.**

Milcor Steel Company vice-president, **J. Harry Christman,** who has been in charge of the concern's Chicago Branch since 1936, has been assigned new duties connected with special sales problems and merchandising policies. Mr. Christman was appointed sales manager of the company in 1919 and vice-president in 1927. **Byron B. Barker** has been named to take Mr. Christman's place as manager of the Chicago branch. **Don L. Rossiter** has been appointed district sales manager of the Canton, Ohio, branch of Milcor.

Wilbur E. Geiser, who has been on loan for the last eight months to the scheduling department of the War Production Board's valve and fittings section, with headquarters in Washington, has returned to his post as manager of the Philadelphia office of **Tube Turns, Inc.** Broad Street Station Building.

Ilg Electric Ventilating Co. has moved its San Francisco branch office to larger headquarters at 826 Sharon Building, 55 New Montgomery Street, San Francisco 5, Calif. **James S. Rose,** formerly supervisory methods engineer in charge of heating and ventilation, Curtiss-Wright Company, Buffalo, will manage the new branch office.

Trustees of the **John B. Pierce Foundation** have announced an arrangement by which many of the research developments and products of its laboratories will be made generally available to the public through the **Stran-Steel Div., Great Lakes Steel Corp.,** Detroit, Mich. The Pierce Foundation is a privately endowed organization engaged in research, educational, technical and scientific work, and has been a leader in the development of mass-produced, low-cost housing. The Foundation has experimented for years with the pre-engineered house and its utilities, especially heating, ventilating and sanitary equipment. Funds for carrying on the activities of the Foundation are provided by an endowment created by the late John B. Pierce. Distribution of the complete oil-fired line of Evanair heating equipment will be handled nationally and exclusively through the seventy-nine offices of the **Westinghouse Electric Supply Company,** according to A. W. Shields, general sales manager, **Evanair Division, Evans Products Co.,** Detroit.

Tube Turns, Louisville, Kentucky, announces the reopening of its Los Angeles office in the Van Nuys Building with **James H. Withers** in charge. For the last nine years Withers has been associated with valve, fitting, and industrial supply firms in the West Coast area.

Charles L. Saunders, former vice president of Minneapolis-Honeywell Regulator Co., has resigned as branch chief of the WPB Office of Civilian Requirements, to become vice president of **Wheelco Instruments Company,** Chicago. Mr. Saunders joined WPB in March, 1942, to organize an instrument branch to correlate manufacturing problems of the instrument industry with war production. He previously served as sales correspondent and district manager of Brown Instrument in Birmingham, Houston, Pittsburgh and Chicago. With acquisition of the Brown company by Minneapolis-Honeywell in 1935, Mr. Saunders was appointed Chicago regional sales manager, and two years later became resident vice-president of the company.

A. O. Smith Corporation, Milwaukee, has appointed **H. L. Bilsborough** as manager of stoker sales. Mr. Bilsborough entered the stoker business in 1928 in Chicago. His first connection was with the Iron Fireman Mfg. Co. In 1934 he became associated with Fairbanks, Morse & Co. as sales manager of its newly formed stoker division. He was promoted to manager of the division in 1938 and held that position until resigning in February of this year.

American Screw Products, Los Angeles, a division of The Deutsch Company, has announced that operations henceforth will be conducted under the firm name **The Deutsch Company.** The company manufactures hydraulic valves and fittings.

Increasing research and product development personnel both for furtherance of the war effort and engineering of new products for post-war sales have led to the appointment or promotion of five men in the **Ilg Electric Ventilating Co.** organization. **Frank P. Bleier,** research and development physicist since 1942, has been named director of the new Ilg research laboratory, now in operation. Since he has been with Ilg, Mr. Bleier has worked closely with officials in the U. S. Navy and Maritime

Frank P. Bleier

Raymond V. Pfautsch

Commission developing special marine ventilating apparatus. Perhaps his most outstanding achievement for the war effort was his design of a complete line of axial-flow fans now used by the marine industry, but scheduled for general use after the war. **Raymond V. Pfautsch,** formerly an engineer assigned to new product design, has been named assistant chief engineer. Mr. Pfautsch has spent the past fifteen years with the Ilg organization. **Richard Hanford,** another member of the engineering department, has been given the title of electrical engineer. **A. J. Lenke** has been appointed production manager, and **George Biggott,** who came to the company in 1942 as a production specialist, has been placed in charge of production planning and scheduling. All of these appointees will work under the supervision of **W. H. Rietz,** who continues as vice-president in charge of manufacturing.

MetalFusion Corporation of America has become a subsidiary of **Cook Electric Company,** according to Walter C. Hasselhorn, president of the latter company.

(Continued on page 100)

LOW COST AXIAL FLOW PUMPS
The Right Answer to Flood and Drainage Problems

Industries or municipalities faced with flood dangers will find a solution to their problem in Economy's line of Axial Flow Pumps. Although low in initial cost, these sturdy, dependable, compact units are specially designed to handle tremendous volumes of water. Because their price is much lower than that of centrifugal pumps of equivalent efficiency and mechanical construction, Axial Flow Pumps of very large capacities can be provided for peak flood conditions, without exorbitant expenditure. The pump is of the propeller type, discharging into a guide vane section. Bearings are of heavy duty design, bronze or non-metallic water lubricated internally and ball thrust bearings outboard.

Horizontal Axial Flow Pump with Variable Speed Drive

APPLICATIONS

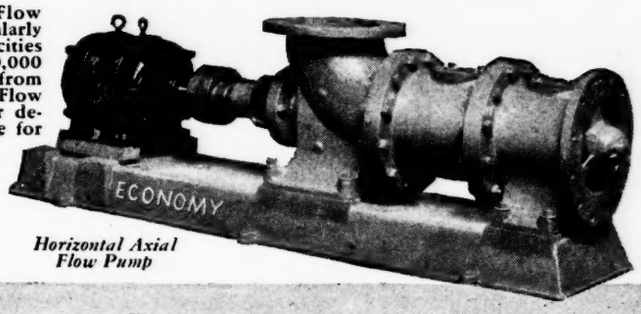
Economy Axial Flow Pumps meet the need of efficient, low priced apparatus for

• Flood Control • Drainage and Sewage Pumping • Agitator Service • Irrigation, etc., etc.

They are designed for either horizontal or vertical settings, for drive by electric motors, gasoline or oil engines, water turbines, etc., and are easily arranged for automatic control. If you have a pumping problem—write today for Economy literature, and ask about free Engineering service.

Economy Axial Flow Pumps are particularly adaptable for capacities from 1200 to 50,000 G.P.M. at heads from 5' to 25'. Mixed Flow Pumps of similar design are available for heads up to 45'.

18 in. Vertical Axial Flow Pump



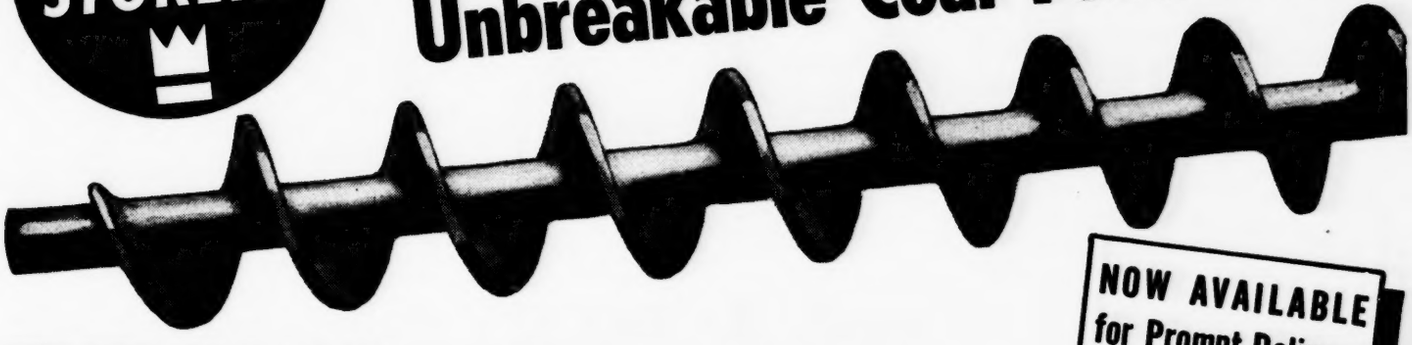
Horizontal Axial Flow Pump

ECONOMY PUMPS, INC.

HAMILTON, OHIO, U. S. A.

For STOKERS

The CROWN Unbreakable Coal Feed Screw



NOW AVAILABLE for Prompt Delivery

WELDED All-Steel Worm—All Sizes—All Pitches

★ For replacement or production needs, Crown is now able to offer for prompt delivery its all-steel Coal Feed Screw. Available with right or left hand screw, in all sizes and pitches, tapered or straight, and in combinations of pitches. For both domestic and industrial stokers, the Crown Coal Feed Screw insures longer and continuous operation because it is all-steel and because it is machined so smoothly that wear is reduced to a minimum. **This smooth surface is your assurance, too, that coal will flow freely and easily through the flights. Prompt delivery is possible because production requires less time on Crown's automatic machines and because** the steel used in Crown's Coal Feed Screw while critical, is more easily procured.

In ordering give complete specifications on size and design.

CROWN IRON WORKS COMPANY

1229 Tyler St., N. E. *Since 1878* **Minneapolis, Minn.**

Do You Know a better way

...to heat a house?

...to cool a house?

...to heat water?

...to refrigerate food?

...to build a temperature control?

...to make an automatic valve?

If you have developed a better way to do any of these things and if your ideas can be protected... *here* is your opportunity!

The AiResearch Manufacturing Company is preparing *now* for the postwar period and is in the market for ideas, inventions and products for postwar development, manufacture and sale.

AiResearch has skilled engineering and production groups at present engaged in development and manufacture of oil coolers, intercoolers, exhaust heat exchangers and cabin pressurizing equipment for wartime aircraft. In peacetime this organization will continue the job of improving aircraft, for which it has three times won the Army and Navy "E" since Pearl Harbor. But also its fully equipped laboratories and manufacturing plants will be able to develop improved peacetime products for better postwar living... and its well-organized sales force will be given the job of their promotion.

On an outright purchase or royalty basis, AiResearch is ready *now* to negotiate for exclusive rights to those ideas and inventions believed practical to its abilities and resources. AiResearch would like to hear about *your* idea. Write as fully as possible. You will receive a prompt answer and your correspondence will be held in confidence.

Address: **POSTWAR PLANNING COMMITTEE**
AiResearch Manufacturing Company
9851 Sepulveda Boulevard, Los Angeles 43, California

AiResearch
DIVISION OF
THE GARRETT CORPORATION

(Continued from page 98)

Bituminous Coal Research, Inc. has appointed **Elmer R. Kaiser** assistant director of research for the bituminous coal industry's expanded technical program. Mr. Kaiser will be located in the new Pittsburgh office of Bituminous Coal Research, Inc., 719 Oliver Building, Pittsburgh 22, Pa., where Dr. H. J. Rose, the recently-appointed director of research, has already established headquarters. A graduate of the University of Wisconsin, from which he received his bachelor's and master's degrees in mechanical engineering in 1934 and 1935, respectively, Mr. Kaiser has been engaged in coal research since 1932. He has been associated with the coal industry's research program since 1935 as a research engineer on the staff of Battelle Memorial Institute.

Following a period of research and field surveys on coal for residential and industrial stokers, on segregation of coal in bunkers, and on pulverized coal. Mr. Kaiser took over in 1939 the task of organizing the coal and allied industries' support of coal research, from which the programs since 1940 have resulted. While continuing the latter activities as assistant to H. N. Eavenson, president, he will assist Dr. Rose in the organization and administration of research projects sponsored in behalf of the bituminous coal industry.

Guy E. Hairston has been appointed manager of the Atlanta district sales territory by **American Machine and Metals, Inc.**, East Moline, Ill. Mr. Hairston was formerly district sales manager of American Radiator and Standard Sanitary Corporation in the southeastern area of the United States.

Manning, Maxwell & Moore, Bridgeport, Conn., has appointed **E. M. Dunlap** as manager of distributor sales. He will take complete charge of distributor distribution of the products of the company's Boston and Bridgeport works. **Albert W. Coleman** has been appointed to the newly-created position of sales manager. Mr. Coleman, who has been with the company for the past twenty-three years, will make his headquarters at Bridgeport. He has for many years served in different sales capacities and since 1936 has acted as Pacific Coast manager with headquarters at Los Angeles. **Rudolf Beck** has been appointed chief engineer of the American Instrument Division.

Albert W. Coleman

Minneapolis-Honeywell Regulator Co. opened an exhibit that started August 9 in the Rockefeller Center office of the East River Savings Bank, New York. It shows the company's personally controlled heating controls for post-war apartments.

In order to meet increased demands for industrial refrigeration equipment by industry, **Frostrode Products** has moved to a larger plant at 19929 Exeter, Detroit 3, Mich. The new plant facilities will permit stepped-up delivery schedules on the company's refrigerated welding units, resistance welding electrodes, coolant coolers, low temperature cabinets and cold treating equipment.

George A. Soules, since 1935 factory superintendent for **Elgo Shutter & Manufacturing Co.,** Detroit, Mich., has been appointed sales manager. His brother **Earl A.** who was sales manager for the past seven years is now with the **Advance Fan & Blower Co.,** Detroit, Mich., to handle the distribution of the Moyno pump in the entire state of Michigan.

Elevation of three executives of **The Weatherhead Co.**, Cleveland, to vice-presidencies, and the appointment of a fourth to the post of assistant to the president, is announced. **H. Church** is the newly appointed vice-president in charge of sales; **George H. Hufferd** becomes vice-president in charge of engineering; and **Robert P. Gibson** will serve as vice-president in charge of automotive sales. **Morris H. Wright** is the new assistant to the president. Mr. Church joined Weatherhead in 1936 as sales engineer and later became the manager of the aviation sales division. Mr. Hufferd joined Weatherhead as chief development engineer in 1943, while Mr. Gibson has been associated with Weatherhead for 15 years. Mr. Wright came to Weatherhead from the Acme Steel & Malleable Company where he was assistant general manager.

Harvey-Whipple, Inc., Springfield, Mass., announces the return to the firm of **Theodore A. Hodgdon**, after an absence of 28 months. Early in 1942 Mr. Hodgdon left to join the technical staff at Pratt & Whitney Aircraft, and for the past two years has been assistant advertising manager of Pratt & Whitney. In returning to Harvey-Whipple, Mr. Hodgdon will fill a newly created position as director of marketing. Prior to the war, he was for five years Advertising Manager for Harvey-Whipple.

American Radiator and Standard Sanitary Corporation has elected **Robert B. Dickson** as director. Mr. Dickson is president of Kewanee Boiler Corporation, a member of the executive committee, and a member of the finance committee to fill unexpired terms of the late Martin J. Beirn. **Donald D. Couch**, formerly assistant general manager of sales of the corporation, was elected vice-president and general manager of sales, also to succeed Mr. Beirn.

Benton J. Sauppee has been appointed district sales manager of the St. Louis district territory of **American Machine and Metals, Inc.** Mr. Sauppee recently has been engaged in professional engineering services in Kentucky and Tennessee. He has established district offices in the Arcade Building, Eighth and Olive Streets, St. Louis.

John Barnard, market research specialist, 14 National Mutual Buildings, 43 Rissik St., Johannesburg, South Africa, offers a market research and trade data service for the development of post-war trades in South Africa and Rhodesia and can introduce wholesale distributors or manufacturers representatives who wish to arrange tie-ups, preferably on an exclusive agency basis.

The Weatherhead Company, Cleveland, has established an honor roll of Weatherhead jobbers whose association with the company is of more than five years standing. Over 1000 of the 1800 Weatherhead jobbers in the United States and Canada were found to be eligible.

E. E. Quimby has been elected to the position of commercial vice-president of **Economy Pumps, Inc.**, specializing in sales transactions for the very large projects which are too involved for a resale agency. Mr. Quimby is senior partner of **Quimby-Ryan**, 1 East 42nd Street, New York City. His firm has represented Economy Pumps since 1928 and he will continue his active connection with Quimby-Ryan in addition to his new relation with Economy. Mr. Quimby for several years was sales manager for the Quimby Pump Company, New York, and later was vice-president and general manager of the Sundh Electric Company of Newark, N. J.

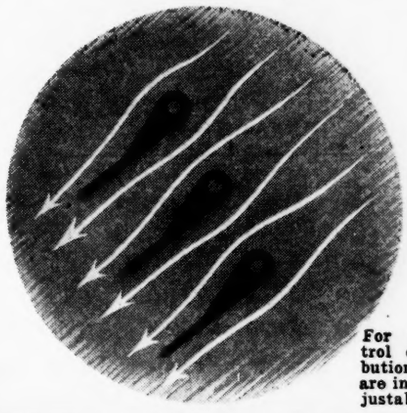
E. E. Quimby

(Concluded on page 102)

Quiet

AIR DIFFUSION

—even at High velocity



For positive control of air distribution these blades are individually adjustable.

WITH THESE EXCLUSIVE *Streamlined* BLADES

Streamlined blades are used to obtain unobtrusive air diffusion. The exclusive shape of these blades allows them to handle high-velocity air with a maximum of efficiency and a minimum of sound. The spacing of the blades provides the required free area.

Waterloo
AIR DIFFUSERS

Efficient Registers and Grilles are invaluable to satisfactory heating or air conditioning. FLEXIBILITY in control and diffusion of the air stream is especially important—to permit prompt adaptation to changing conditions. Such flexibility, coupled with quiet operation (even at high velocities), is an exclusive feature of Waterloo Air Diffusers.

Today, Waterloo's skill in precision manufacturing is engaged in important War production. When the war is over—plan to use these products for BETTER heating and air conditioning results.

Waterloo Register Co.
INCORPORATED 1902
WATERLOO, IOWA SEATTLE, WASH.

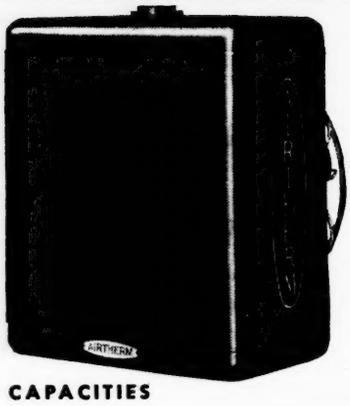
AIRTHERM UNIT HEATERS

Now Available with Copper Coils

Available on AA5, or Better, Priority

Horizontal Unit Heaters

(Copper)

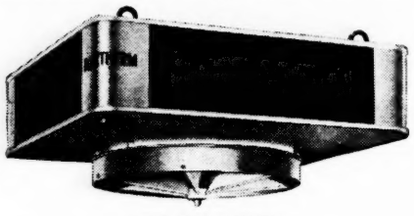


CAPACITIES

Model	Btu/hr.	Motor HP	Motor RPM	CFM	Final Temp. °F.
M-25C	25,400	1/45	1580	410	114
M-35C	35,000	1/33	1580	585	114
M-45C	45,000	1/33	1580	685	118
M-60C	60,000	1/20	1140	1020	114
M-87C	87,000	1/8	1140	1500	113
M-114C	114,000	1/8	1140	1905	114
M-140C	140,000	1/6	1140	2400	113
M-170C	170,000	1/6	1140	2650	118
M-215C	215,000	1/4	1140	3600	114
M-278C	278,000	1/2	1140	4300	118

Btu/hr. computed at 2 lb. gage steam pressure and 60°F. entering air.

Vertical Delivery Unit Heaters



CAPACITIES

Model	Btu/hr.	Motor HP	Motor RPM	CFM	Final Temp. °F.
V-145C	145,000	1/8	1140	2700	114
V-175C	175,000	1/3	1725	3400	111
V-191C	191,000	1/4	1140	3300	118
V-234C	234,000	1/2	1725	4300	114
V-260C	260,000	1/2	1140	4550	115
V-340C	340,000	1/2	1140	5600	120
V-480C	480,000	1	1140	8000	120
V-600C	600,000	1 1/2	1140	11000	115

Send today for bulletin giving complete information and prices.

AIRTHERM

MANUFACTURING COMPANY

711 South Spring Avenue • Saint Louis 10, Missouri

(Concluded from page 101)

Philip H. Bills, vice-president and treasurer of the **Gilbert & Barker Manufacturing Company** has been elected president of the Springfield (Mass.) control of the **Controllers Institute of America. C. C. Phelps,** secretary-treasurer of the **Wolverine Brass Works,** Grand Rapids, was elected vice-president of the Western Michigan Control of the national organization. **J. Walton St. Clair,** vice-president of the **Hajoca Corporation,** was similarly honored by the organization's Philadelphia Control and **Paul H. Wernicke,** assistant comptroller of the **Minneapolis-Honeywell Regulator Company,** was elected vice-president of the Twin Cities Control. **Frank S. Hecox,** secretary-treasurer and controller of the **Iron Fireman Mfg. Co.,** was re-elected vice-president of the Portland (Oregon) Control. The Institute is a technical and professional organization of controllers devoted to the improvement of controllership procedure.

Rybolt Heater Company, Ashland, Ohio, has appointed **E. T. Selig, Jr.,** as director of engineering. Mr. Selig's most recent connection was with the construction of the Geneva Steel Works at Geneva, Utah, just completed. Prior to this project he was chief mechanical engineer for the construction of Camp Hale, Colo. In this camp several hundred buildings were constructed with warm air heating systems which were designed under Mr. Selig's direction to accommodate the prevailing rare atmosphere and low temperatures. Previously, he was chief research engineer for Campbell Taggart Research Corp., Kansas City, Mo. Earlier in his career, Mr. Selig was an industrial fellow on the Anthracite Industries Fellowship at Mellon Institute of Industrial Research in Pittsburgh.

M. J. Boho has been appointed assistant general manager of sales of **Hagan Corp.,** Pittsburgh. Mr. Boho will assist D. J. Erikson, vice-president in charge of sales.

Delco Appliance Division, General Motors Corporation, has appointed **M. Lawrence Judd** sales manager of appliances, and **Charles E. Smith,** assistant sales manager in charge of oil heating equipment.

Earl McGee has been appointed works manager of **Renown Stove Company.** He was formerly with The Standard Gas Equipment Company.

Pittsburgh Screw and Bolt Corporation has appointed **Robert L. Irvin** as works manager of its Graham plant. **George H. Lee, Sr.,** former works manager of the Graham plant, will devote all his time to experimental and advisory work for all the plants of the corporation.

L. A. Foster Company, contractors and distributors for **The Eagle Picher Lead Company,** has moved its office, warehouse and contract department to 1519-21 N. Broadway, St. Louis 6, Mo.

Jas. P. Marsh Corp., Chicago, has appointed G. S. Gaisford as manager of the Marsh export department located at 155 E. 44th St., New York, N. Y. Mr. Gaisford has been for many years eastern division manager of the Marsh organization.

Frank D. Popowics, associated for many years with the electrical division of Colt's Patent Firearms Mfg. Co., Chicago, is now a member of the sales engineering staff of **Allen-Bradley Co.,** in New York. **Charles M. McCoombs,** formerly New England district manager for Bull Dog Electric Products Co., has joined the sales engineering staff of Allen-Bradley in Boston, as assistant to M. H. Hallenbeck, district manager.

Getting Personal

Gordon V. Bond

With promise of considerable activity in the construction of new commercial airports after the war, it is with some interest that we present Gordon V. Bond, field engineer, Carrier Corp., author of the article Air Conditioning Airport Control Towers, page 53.

Born in Plainfield, N. J., he received his B.S. in Engineering from Princeton University. He followed this with an LL.B. from Fordham University.

His early engineering work included drafting, product development, manufacturing and sales. Mr. Bond joined Carrier in 1934 and proceeded from research to application engineering and then to the sale of air conditioning to national buyers. At present he designs air conditioning and refrigerating systems to meet special requirements of the Army and Navy. He is a member of the Society of American Military Engineers. Outside of office work, his chief interest is his two lively daughters; secondary hobbies are radio, music and sailing.

It is only natural to be interested in what the other fellow is doing, and about his problems. That is what makes back fence gossip so popular and why radio commentators have such a large following. To give you an insight into what the other man in your field is thinking regarding post-war developments and design, contacts were made with over 1,300 consulting and architectural engineers by HEATING AND VENTILATING. See page 83 for findings on features that need further development after the war, and practices most affected by the war.

Dr. R. C. Johnson

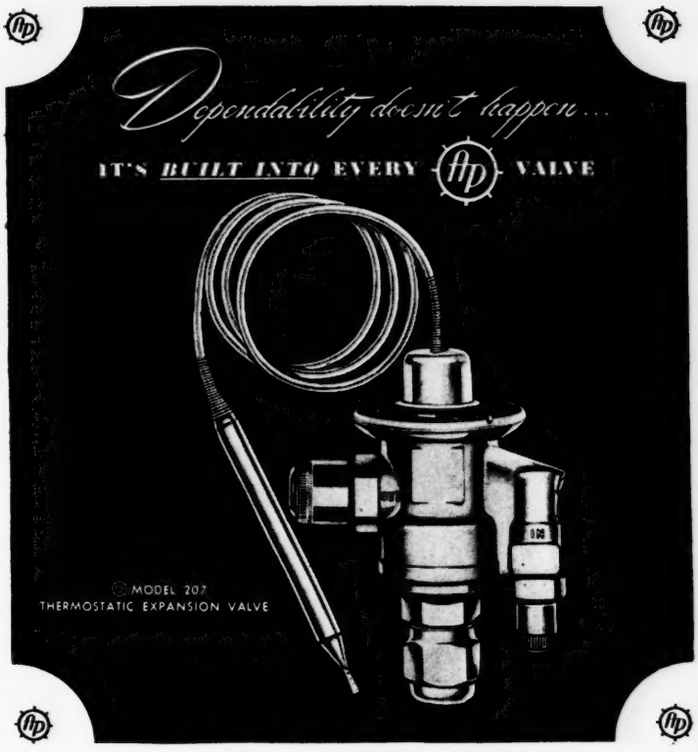
Dr. Raymond C. Johnson, vice-president in charge of research of Anthracite Industries, Inc., and director of their laboratory at Primos, Pa., is the man largely responsible for the development of the revolutionary new anthracite combustion principle described on page 56. The photograph shows him addressing a group at the laboratory, with the aid of a portable microphone.

Born in Gillespie, Ill., he received his basic science training at Monmouth College, Ill., his Master of Science degree at Carnegie Institute of Technology, and his Ph.D. at the University of Pittsburgh. Besides he holds the professional degree of Chemical Engineer, and is a member of the American Institute of Mining and Metallurgy.

He has been in anthracite coal research since 1927. He was associated with the U. S. Bureau of Mines, and later with the Philadelphia and Reading Coal and Iron Co., as a research engineer. In 1937 he joined the staff conducting research for Anthracite Industries, Inc., at the Mellon Institute of Industrial Research. In 1941 Dr. Johnson was appointed director of the Anthracite Industries laboratory.

While his favorite hobby is photography, we are informed that he is good at both golf and bridge.

(Concluded on page 104)



MODEL 207
THERMOSTATIC EXPANSION VALVE

The versatility, dependable refrigerant control efficiency, compact size, durability, ease of inspection, and other advantages have made A-P Model 207 one of the most popular valves among Refrigeration Service Engineers responsible for thousands of installations. Adaptable to smaller types of units, display cases, ice cream cabinets, sharp freezers, and air conditioning units, it maintains a constant superheat over a wide range of evaporator temperatures. Superheat is readily adjustable from 0° to 30° F. Capacity, from 1/4 ton Freon to 1 ton Methyl or Sulphur. Write for complete bulletin and service data.

AUTOMATIC PRODUCTS COMPANY
2462 North Thirty-Second Street, Milwaukee 10, Wisconsin

DEPENDABLE
REFRIGERANT VALVES

STOCKED AND SOLD BY PROGRESSIVE REFRIGERATION JOBBERS EVERYWHERE. RECOMMENDED AND INSTALLED BY LEADING REFRIGERATION SERVICE ENGINEERS.

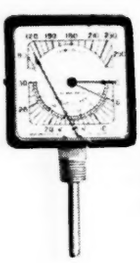
MOTOCO *Indicating Thermometer Model F-1 $20.*

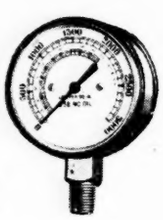
PROTECTION for Heating and Power Equipment

An important part of heating and power equipment is the MOTOCO Indicating Thermometer. It helps to insure efficient operation by providing accurate temperature indication.

MOTOCO Thermometers are the development of many years' experience in manufacturing dial-type instruments for measuring and recording. Their distinctive design eliminates screws, levers, gears, hairsprings and other delicate parts subject to wear and adjustment. Strongly and simply constructed, MOTOCO Indicating Thermometers give long service. Priced low, due to specialization and large-scale production, they are economical and valuable accessories.

Available with rigid stem or flexible capillary tubing for distant reading. Information on models, sizes and prices on request.



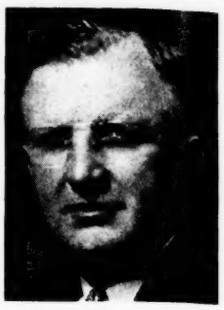


Illustrated here are two of the many types of MOTOCO precision instruments made for specific industrial applications. Left: Combination Thermometer, Pressure and Altitude Gauge. Right: Pressure Gauge used in oxy-acetylene welding.

THE ELECTRIC AUTO-LITE COMPANY
INSTRUMENT AND GAUGE DIVISION
CHRYSLER BUILDING, NEW YORK 17, N. Y.

In addition to a wide range of thermometers and gauges, we specialize in the production of instruments of special design for use as a standard part of manufacturers' equipment. Ask us for recommendations for your postwar needs.

(Concluded from page 103)



Earl C. Payne

Earl C. Payne, consulting engineer, Consolidation Coal Co., received his M.E. degree from the University of Michigan. For the next few years he was with the Burroughs Adding Machine Co., Maxwell Motor Corp., and the Michigan Alkali Co., concerned with problems involving heating and ventilation, power generation, and combustion.

Following a few years with the industrial sales department of the Westinghouse Electric & Mfg. Co., he joined the Consolidation Coal Co. in 1927 as western service manager. Since that time has been the company's New York sales manager, director of industrial sales, eastern sales manager, and since 1935, consulting engineer. See his article, page 63, Saving Fuel in the Home.

Mr. Payne is a member of the Technical Advisory Committee of the Bituminous Coal Research Bureau; member of the A.S.M.E., American Institute of Mining and Metallurgical Engineers, and the Engineers' Club of New York.

Terry Mitchell

Born in Richmond, Va., **Terry Mitchell,** later attended M. I. T. from which he graduated in 1921. He received his M.E. degree from the University of Delaware.

During World War I he served as a cadet pilot. After the war, he was employed by the Bethlehem Shipbuilding Co., and the Westinghouse Electric & Mfg. Co. Since 1925, he has been with the Frick Co., Waynesboro, Pa., where at present he heads their advertising department. In addition, for the past 15 years he has been editor of their publication the "Frick System." His article, Accuracy Aided in Research and Test, is on page 80.

Besides his writing, he finds time to indulge in golf. His other hobby is to draw in pastel and oil painting.

Blower Wheels

A 20-page bulletin 24-1, standard size, loose-leaf, punched, entitled "Janette Blower Wheels" and including descriptive and illustrative material relating to the company's wheels and, in addition, comprehensive tables on performance data, dimensions and capacities. *Janette Manufacturing Company, 556 W. Monroe St., Chicago 6, Ill.*

Heat Exchangers

A 24-page catalog No. M-8802 devoted to Karbate corrosion-resistant heat exchange equipment. Includes charts and tables covering the heat conductivity and physical and chemical properties of carbon, graphite and Karbate materials. Thirty-nine illustrations. *National Carbon Company, Inc., 30 E. 42nd St., New York 17, N. Y.*

Welding Symbols

A 16¾ x 21⅝ inch wall chart, illustrating the basic characters of welding symbols recommended as American standard by The American Welding Society. The graphical language of the welding industry is illustrated separately for fusion welding, for resistance welding, and for those requiring both fusion and resistance welding. The location of the symbols, numerical and other data on the reference line always has definite significance and this is illustrated to show the standard manner of placing proper information on the symbols. Twenty-three typical welded joints and sections, covering butt welds, lap welds, tee welds, corner welds, and edge welds, are well illustrated and marked with the standard welding symbols applying to that particular joint or section. *The Hobart Brothers Co., Hobart Square, Troy 1, Ohio.*

Unit Heaters

Three loose-leaf-punched data sheets giving detailed dimensional, rating, air flow, motors and fan characteristics, gas connections, and other information for the company's line of suspended gas-fired unit heaters. Form DB844 relates to blower type unit heaters; DD844 to duct type heaters; and DF844 to propeller fan type heaters. *Reznor Manufacturing Co., Mercer, Pa.*

Unit Heaters

New catalogs on Modine horizontal and vertical delivery unit heaters, bulletins 144-A and 144, respectively. Include complete descriptive data on the new lines of copper condenser unit heaters with sizes and steam and hot water performance tables. Also incorporated into the bulletins is engineering information on the company's low outlet temperature models designed for use on steam pressures of 30 lb and greater. *Modine Manufacturing Co., Racine, Wis.*

Flat-Belt Drive

A 24-page catalog FBD-44 giving complete information on American steel split pulleys and bushings, shaft collars, shaft hangers and bearings, split and solid conveyor pulleys, Hi-Torque motor pulleys, belting and Econ-o-matic drives for short-center flat-belt drives. Application, design and advantages of group drives are also discussed. *The American Pulley Co., 4200 Wissahickon Ave., Philadelphia 29, Pa.*

Electric Heaters

Bulletin 44U, describing the company's electric unit heaters. The line includes standard sizes ranging from 1.5 kw to 60 kw for ceiling, wall or post suspension although the six smaller sizes, 1.5 to 7.5 kw, are described as portable or suspension types. Tables give dimensions, capacities and weights. *Electric Air Heater Co., Mishawaka, Ind.*

Fans

Three standard size, loose-leaf-punched bulletins: bulletin 432, 32 pages, contains descriptive and illustrative material together with comprehensive dimensional and capacity tables on the company's type SSP industrial and heat fans; bulletin 442, 8 pages, is devoted to the company's Comet Exhaustair and industrial ventilating fans and accessories, including capacity and industrial data on the company's axial flow fans, penthouses and louvers; bulletin 441, 8 pages, devoted to general purpose fans—portable self-contained units of medium capacities for low-pressure industrial and ventilating applications. *The New York Blower Company, 32nd St. and Shields Ave., Chicago 16, Ill.*

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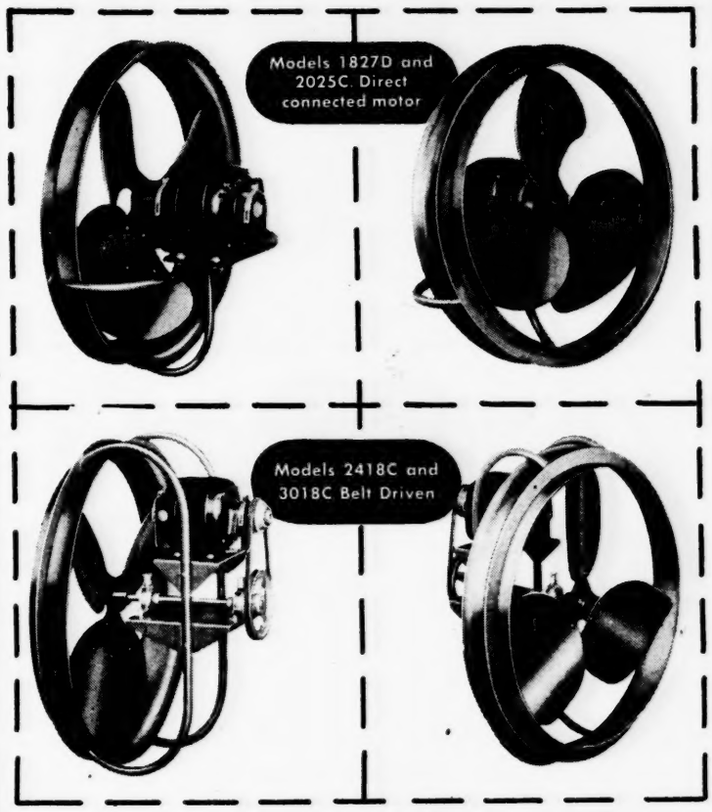
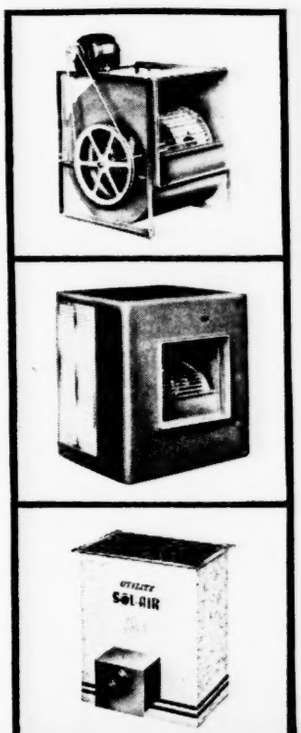


NEW UTILITY FANS ARE *Truly Quiet*

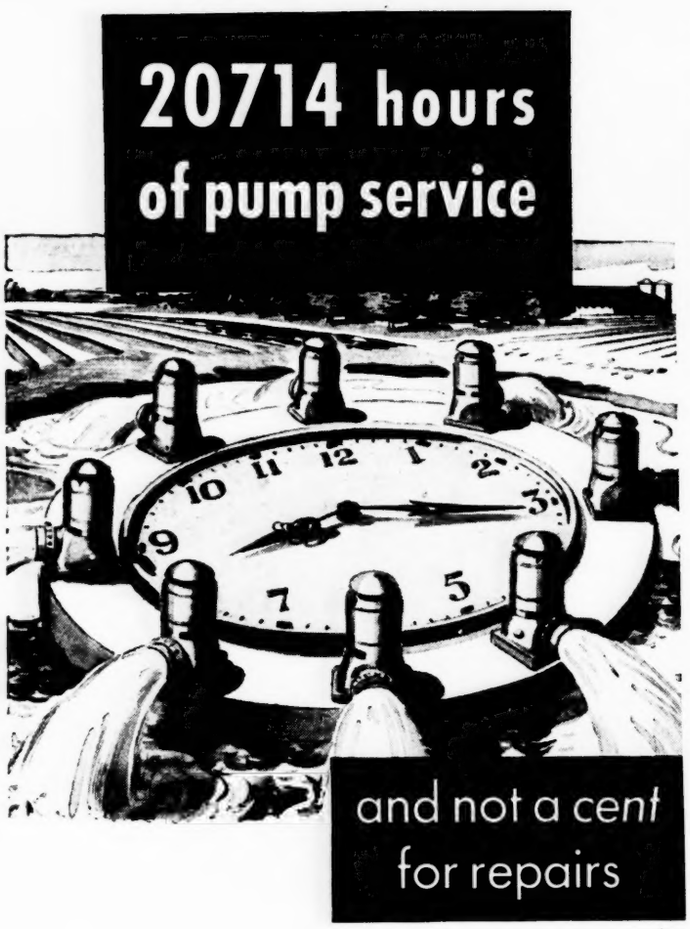


The streamline fan ring permits a smooth flow of air with minimum turbulence and noise . . . the fully enclosed motor is resilient mounted . . . low rotative speeds further air quiet operation. Other features are low power consumption and rigid, welded construction. Belt-driven models have variable pitch pulley for simple speed adjustment. All models are easily installed by means of the rigid, heavy gauge steel ring mounting.

Utility Propeller Fans, Centrifugal Blowers and Evaporative Air Coolers are available under WPB regulations. Write for complete catalogs and literature.

UTILITY FAN CORPORATION
4851 South Alameda Los Angeles 11, California

Peace-time manufacturers of the Famous Utility Air Koolers, Blowers, Fans, Floor Furnaces, Circulating Heaters, Unit Heaters, Forced Air Furnaces.



Here is a typical Peerless performance record: A Peerless Deep Well Pump was installed January 29, 1939, in one of the "toughest" pumping locations in America. It was pulled June 2, 1944, to permit installation of another Peerless Pump of greater capacity. For almost 5½ years it was operated at an average of 10 hours daily, with a total of 20,714 hours of meritorious service. Never was a single cent spent on repairs. After pulling the pump, inspection revealed no appreciable wear. It has been installed in a near-by well and is expected to give years of additional service with little or no repair cost. This is the kind of service for which Peerless is noted—low cost of upkeep and unfailing dependability. Make Peerless your choice if economy is your objective.

PEERLESS PUMPS

TURBINE
HI-LIFT
HYDRO-FOIL

PEERLESS PUMP DIVISION
FOOD MACHINERY CORPORATION
301 West Avenue 26, Los Angeles 31, California
1250 Camden Avenue S.W., Canton 6, Ohio
Other Factories: San Jose 5, Fresno 16, California

(Concluded from page 105)

Pulleys

A standard size 8-page catalog HT-44, describing the composition, design, and manufacturing methods of Hi-Torque pulleys. Contains dimensions and list prices of standard sizes and complete price information for made-to-order pulleys. *The American Pulley Co., 4200 Wissahickon Ave., Philadelphia 29, Pa.*

Safety Valves

A new safety and safety relief valve catalog covering the company's consolidated line of valves for all industries. All valves are illustrated, scope of design is given together with parts and materials, dimensions and other general information such as capacity tables, sizing charts and selection charts. *Manning, Maxwell & Moore, Inc., Bridgeport, Conn.*

Welding

A 48-page standard size booklet devoted to Fleet-Welding, a technique of arc welding which greatly increases the speed of process over conventional methods and cuts cost as well. Published by *The Lincoln Electric Co., Cleveland, Ohio.*

Turbine Cleaning

A booklet, "Turbine Cleaning Manual," which describes for the turbine operator a new technique for the solvent cleaning of turbines by the use of Shell turbo cleaner, recently developed. The procedure explained in the manual is the result of many years of experience gained in cleaning both stationary and marine turbine lubricating oil systems, and it sets forth techniques to be followed in the cleaning of both new and old installations. Thorough cleaning of new equipment is advised in order to remove all foreign materials which may be present such as loose mill scale, metal chips, core sand, gasket compound, slushing compound, run-in-oil, and any loose rust. *Lubricants Department, Shell Oil Co., 50 West 50th St., New York 20, N. Y.*

Post-War Designs

(Concluded from page 83)

answers which were unclassifiable. Of those whose answers were to the point, the majority (43.4%) replied none or very little, while a very small number (5.5%) said that all phases were affected. The phase most affected apparently was air conditioning and refrigeration which was mentioned by 25.4%, followed by heating (12.4%). Other phases included ventilation and air handling (3.5%), controls (3.5%), miscellaneous (3.5%) and pipe and ductwork (2.8%).

Among the specific points mentioned as being affected were the following:

Use of less refrigeration and air conditioning with separate means of dehumidification
Simplification
Increased use of welding
Economy of design
Increased use of one-pipe hot water
Increased use of unit heaters
Substitution of non-metallic ductwork and piping
A greater amount of marine work
Increased use of ventilation
More industrial work and change in fuel selection.

Replies to the remaining questions in the survey will be analyzed in a forthcoming issue.

COMING EVENTS

SEPTEMBER 21-22—Open forum of the Indoor Climate Institute, Book-Cadillac Hotel, Detroit, Mich. Executive Secretary, Arthur E. Schanuel, Penobscot Building, Detroit.

OCTOBER 2-5—Fall meeting of the American Society of Mechanical Engineers to be held at the Netherlands-Plaza Hotel, Cincinnati, Ohio. Secretary, Clarence E. Davies, 29 W. 39th St., New York 18, N. Y.

NOVEMBER 15-19—Third National Chemical Exposition will be held at the Chicago Coliseum, Chicago, Ill. Sponsored by Chicago Section of the American Chemical Society. Headquarters for the show at 330 So. Wells Street, Chicago 6, Ill.

NOVEMBER 27-DECEMBER 1—Annual meeting of the American Society of Mechanical Engineers to be held at the Hotel Pennsylvania, New York City. Secretary, Clarence E. Davies, 29 W. 39th St., New York 18, N. Y.

NOVEMBER 27-DECEMBER 2—16th National Exposition of Power and Mechanical Engineering, to be held at Madison Square Garden, New York City. Charles F. Roth, president of the International Exposition Company, New York, is manager of the Exposition.

DECEMBER 10-13—Annual meeting of the American Society of Refrigerating Engineers to be held at the Hotel Pennsylvania, New York City. Secretary, David L. Fiske, 50 W. 40th St., New York 18, N. Y.

JANUARY, 1945— 51st Annual meeting of the American Society of Heating and Ventilating Engineers. tentatively scheduled for last week in January, in Boston, Mass. Hotel not yet decided. Secretary, A. V. Hutchinson, American Society of Heating and Ventilating Engineers, 51 Madison Ave., New York.

ARMY – NAVY E AWARDS

Brown Instrument Co., Philadelphia, Pa.
(Third award)

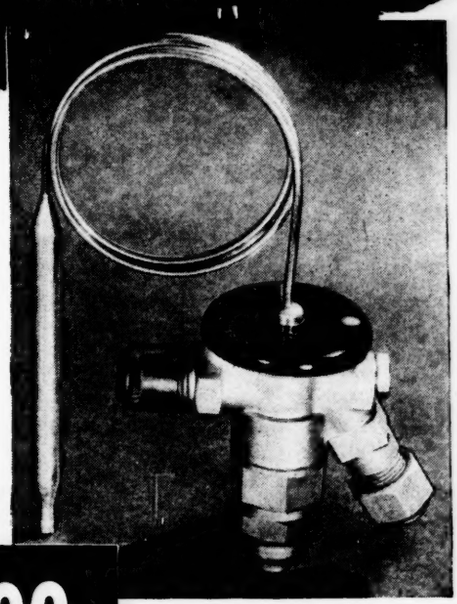
Jenkins Bros., 80 White St., New York, N. Y.
(Third star for "M" pennant)

Battelle Institute, Columbus, Ohio.
(Ordnance Distinguished Service award)

Buffalo Pumps, Inc., North Tonawanda, N. Y.
(Fourth renewal)

The Schaible Company, Cincinnati, Ohio.

A DEPENDABLE CONTROL *for Refrigerants*



V-200 THERMAL EXPANSION VALVE

Thoroughly tested in field use, the V-200 is proving its day-in day-out reliability for an increasing number of users. They endorse its many outstanding features, such as—

- **Easily-removed** *orifice cartridges eliminate need for stocking several sizes for low tonnage installations.*
- **Interchangeable** *orifice cartridges assure proper sizing of capacity to load.*
- **Ample** *diaphragm plus balanced, low-rate adjusting spring.*
- **Carefully-lapped** *hard-faced ball insures tight shut-off.*
- **Frictionless** *pusher pin.*
- **Semi-liquid charged;** *may be placed in ambient temperatures higher or lower than bulb temperatures with no loss of control.*
- **Unmatched** *sensitivity.*

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